

3 1761 04730156 9









Digitized by the Internet Archive  
in 2007 with funding from  
Microsoft Corporation



## CONTRIBUTORS TO VOL. I.

BARNEY, J. DELLINGER, M.D.

BARRINGER, B. S., M.D.

BEER, EDWIN, M.D.

BUERGER, LEO, M.A., M.D.

CORBUS, B. C., M.D.

DODD, WALTER J., M.D.

FOWLER, H. A., M.D.

KEYES, EDWARD L., JR., M.D.

LEWIS, BRANSFORD, M.D., B.Sc., F.A.C.S.

OSGOOD, ALFRED T., M.D.

PILCHER, PAUL MONROE, A.M., M.D.

QUINBY, WILLIAM C., M.D.

SANFORD, HENRY L., M.D.

SMITH, GEORGE GILBERT, M.D.

STEVENS, A. RAYMOND, M.D.

WARREN, GEORGE W., M.D.

WATSON, FRANCIS S., M.D.

YOUNG, HUGH HAMPTON, M.D.

MB  
C

# MODERN UROLOGY

IN ORIGINAL CONTRIBUTIONS BY  
AMERICAN AUTHORS

EDITED BY

HUGH CABOT, M.D., F.A.C.S.

CHIEF OF THE GENITO-URINARY DEPARTMENT OF THE MASSACHUSETTS GENERAL HOSPITAL;  
ASSISTANT PROFESSOR OF GENITO-URINARY SURGERY IN THE HARVARD  
MEDICAL SCHOOL, BOSTON, MASSACHUSETTS

---

## VOLUME I

GENERAL CONSIDERATIONS — DISEASES OF PENIS AND  
URETHRA — DISEASES OF SCROTUM AND TESTICLE —  
DISEASES OF PROSTATE AND SEMINAL VESICLES

---

ILLUSTRATED WITH 368 ENGRAVINGS AND 7 PLATES



155557  
1918/20

LEA & FEBIGER

PHILADELPHIA AND NEW YORK

COPYRIGHT  
LEA & FEBIGER  
1918

DEDICATED

TO THE MEMORY OF

ARTHUR TRACY CABOT

TO WHOSE SKILL AND INTEGRITY AS A SURGEON

AND TO WHOSE WISDOM, GENTLENESS AND FORCE OF CHARACTER

I DESIRE TO EXPRESS MY DEBT OF GRATITUDE



## CONTRIBUTORS.

---

- J. DELLINGER BARNEY, M.D.,  
Genito-urinary Surgeon to Out-Patients in the Massachusetts General Hospital;  
Consulting Genito-urinary Surgeon to the United States Marine Hospital,  
Chelsea, Mass.; Assistant in Genito-urinary Surgery at the Harvard Medical  
School, Boston, Mass.
- B. S. BARRINGER, M.D.,  
Instructor in Urology in the Cornell University Medical School; Assistant  
Urologist in the Bellevue Hospital; Assistant Surgeon in the Memorial  
Hospital, New York.
- EDWIN BEER, M.D.,  
Visiting Surgeon to the Mt. Sinai Hospital; Assistant Visiting Surgeon to the  
Bellevue Hospital, New York.
- LEO BUERGER, M.A., M.D.,  
Instructor in Clinical Surgery in the Columbia University; Associate Visiting  
Surgeon and Associate in Surgical Pathology in the Mt. Sinai Hospital,  
New York.
- B. C. CORBUS, M.D.,  
Instructor of Genito-urinary Surgery in the Rush Medical College, Chicago, Ill.
- WALTER J. DODD, M.D.,  
Instructor in Roentgenology in the Harvard Medical School; Roentgenologist  
at the Massachusetts General Hospital, Boston, Mass.
- H. A. FOWLER, M.D.,  
Professor of Genito-urinary Surgery in Howard University Medical School;  
Genito-urinary Surgeon to the New Emergency and Freedmen's Hospitals,  
Washington, D. C.
- EDWARD L. KEYES, JR., M.D.,  
Professor of Urology in the Cornell University Medical School; Urologist  
to the Bellevue Hospital; Surgeon to St. Vincent's Hospital, New York.
- BRANSFORD LEWIS, M.D., B.Sc., F.A.C.S.,  
Professor of Genito-urinary Surgery in the Medical Department of the St.  
Louis University; Genito-urinary Surgeon to St. John's Hospital; Con-  
sulting Genito-urinary Surgeon to the Frisco Railway Hospital, St. Louis, Mo.
- ALFRED T. OSGOOD, M.D.,  
Professor of Genito-urinary Surgery in the New York University and Bellevue  
Hospital Medical College; Associate Urologist in the Bellevue Hospital;  
Consulting Genito-urinary Surgeon to the Presbyterian Hospital, New York.
- PAUL MONROE PILCHER, A.M., M.D.,  
Consulting Surgeon to the Eastern Long Island Hospital; Surgeon at the  
Pilcher Private Hospital, Brooklyn, New York.
- WILLIAM C. QUINBY, M.D.,  
Assistant in Surgery in the Harvard Medical School; Urologist to the Peter  
Bent Brigham Hospital, Boston, Mass.

**HENRY L. SANFORD, M.D.,**

Instructor in Surgery in the Medical Department of the Western Reserve University; Assistant Visiting Surgeon in the Department of Genito-urinary Surgery in the Lakeside Hospital; Visiting Surgeon to the City Hospital in charge of Genito-urinary Surgery, Cleveland, Ohio.

**GEORGE GILBERT SMITH, M.D.,**

Assistant in Genito-urinary Surgery in the Harvard Graduate School; Genito-urinary Surgeon to Out-Patients in the Massachusetts General Hospital, Boston, Mass.

**A. RAYMOND STEVENS, M.D.,**

Instructor in Genito-urinary Surgery in the New York University; Assistant Attending Surgeon, Urological Service, Bellevue Hospital; Chief of the Urological Clinic in the Presbyterian Hospital, New York.

**GEORGE W. WARREN, M.D.,**

Urologist at the Lutheran Hospital of Manhattan; Associate Genito-urinary Surgeon to St. Mark's Hospital, New York.

**FRANCIS S. WATSON, M.D.,**

Late Lecturer in Genito-urinary Surgery in the Harvard Medical School; Late Surgeon-in-Chief in the Boston City Hospital, Boston, Mass.

**HUGH HAMPTON YOUNG, M.D.,**

Clinical Professor of Urology in the Johns Hopkins University; Director of the James Buchanan Brady Urological Institute; Visiting Urologist to the Johns Hopkins Hospital, Baltimore, Md.; President of the Maryland State Lunacy Commission.

## PREFACE.

---

UROLOGY as a specialty is still young. It is not more than a generation since there have been in America men of eminence who devoted themselves exclusively to this subject.

The surgeons who contributed to the great *System of Genito-urinary Surgery*, by the late Prince A. Morrow, M.D., were none of them, properly speaking, specialists. They were general surgeons whose interests had attracted them to this branch of surgery but who still devoted most of their time to general work.

The development of the specialty has been due to refinements in diagnosis and particularly to the introduction and development of the cystoscope, which though it was introduced by our foreign colleagues, has been brought to its highest development in this country. It is today quite impossible for the general surgeon to master thoroughly the details of urological diagnosis, and though he may be expert in the refinements of operative treatment, he of necessity fulfils the function of the therapist rather than that of the diagnostician.

The development of the last generation has added much to the dignity of urology. More and more the care and management of venereal disease has fallen in the background. Syphilis with its many developments has become almost a specialty in itself and largely separated from urology. It is for this reason that it has seemed wise to abandon the heretofore common joint consideration of genito-urinary diseases and syphilis and consider this disease only insofar as it effects the genito-urinary apparatus. This separation I believe is certain to become more rather than less marked. The relation of syphilis to genito-urinary diseases is purely incidental. Many of its developments belong far more truly to the realm of the internist and the neurologist and its importance in the community justifies its being allowed to develop unhampered by its purely accidental relationship.

An important reason for the production of this book at this time is that there have developed in the last generation in this country a large group of urologists, many of whom are authorities, not only

here but in the world, on their particular subjects, and there can be no doubt that this specialty stands today in America at least on a par with the position which it has made for itself abroad. No longer must recourse be had to foreign clinics to learn the refinements of diagnosis and treatment, and it is owing to this group of men that they should find adequate expression here.

All composite works have an inherent weakness in that they lack the smoothness and balance of works produced by a single author. There is always a certain lack of proportion; there is always obvious difference of opinion where two men approach the same subject from slightly different angles. This, while perhaps objectionable in a book intended solely and chiefly for the use of students, is not in fact objectionable for the use of the profession at large. Such a work as this is in fact a correlated set of monographs and makes up in vigor what it may lack in detail. I am not tempted, therefore, to make any apology for a certain degree of disjointedness, since I do not regard it as a cogent objection. Our intention has been to give articulate expression to American urology, and if in this we have been successful the object has been achieved.

H. C.

BOSTON, MASS.

# CONTENTS.

---

## SECTION I.

### CHAPTER I.

HISTORICAL SKETCH OF GENITO-URINARY SURGERY IN AMERICA . . . . .	17
By F. S. WATSON, M.D.	

### CHAPTER II.

THE CYSTOSCOPE AND ITS USE . . . . .	58
By LEO BUEGER, M.A., M.D.	

### CHAPTER III.

METHODS OF DIAGNOSIS IN LESIONS OF THE URINARY TRACT . . . . .	107
By BRANSFORD LEWIS, M.D.	

### CHAPTER IV.

THE ROENTGENOLOGY OF THE URINARY TRACT . . . . .	147
By WALTER J. DODD, M.D.	

### CHAPTER V.

SYPHILIS OF THE GENITO-URINARY ORGANS . . . . .	161
By B. C. CORBUS, M.D.	

---

## SECTION II.

### THE PENIS AND URETHRA.

### CHAPTER VI.

ANATOMY, ANOMALIES AND INJURIES OF THE PENIS . . . . .	193
By H. A. FOWLER, M.D.	

## CHAPTER VII.

DISEASES OF THE PENIS . . . . .	223
By GEORGE W. WARREN, M.D.	

## CHAPTER VIII.

GENITAL ULCERS . . . . .	240
By B. C. CORBUS, M.D.	

## CHAPTER IX.

INFECTIONS OF THE URETHRA AND PROSTATE OTHER THAN TUBERCULOSIS . . . . .	286
By B. S. BARRINGER, M.D.	

## CHAPTER X.

DISEASES OF THE URETHRA IN THE FEMALE . . . . .	336
By A. T. OSGOOD, M.D.	

## CHAPTER XI.

STRICTURE OF THE URETHRA . . . . .	384
By EDWARD L. KEYES, JR., M.D.	

## SECTION III.

## DISEASES OF THE SCROTUM AND TESTICLE.

## CHAPTER XII.

ANATOMY AND PHYSIOLOGY, MALFORMATIONS, INJURIES AND TORSION OF THE TESTICLE . . . . .	417
By GEORGE GILBERT SMITH, M.D.	

## CHAPTER XIII.

DISEASES OF THE SCROTUM . . . . .	447
By A. RAYMOND STEVENS, M.D.	

## CHAPTER XIV.

HYDROCELE, HEMATOCELE AND VARICOCELE . . . . .	461
By HENRY L. SANFORD, M.D.	

## CHAPTER XV.

INFECTIONS OF THE TESTICLE . . . . .	485
By J. DELLINGER BARNEY, M.D.	

## CHAPTER XVI.

GENITAL TUBERCULOSIS . . . . .	498
By J. DELLINGER BARNEY, M.D.	

## CHAPTER XVII.

TUMORS OF THE TESTICLE . . . . .	534
By EDWIN BEER, M.D.	

## SECTION IV.

## THE PROSTATE AND SEMINAL VESICLES.

## CHAPTER XVIII.

ANATOMY AND PHYSIOLOGY OF THE PROSTATE AND SEMINAL VESICLES . . . . .	541
By WM. C. QUINBY, M.D.	

## CHAPTER XIX.

PROSTATIC OBSTRUCTIONS . . . . .	553
By PAUL MONROE PILCHER, A.M., M.D.	

## CHAPTER XX.

CANCER OF THE PROSTATE . . . . .	657
By HUGH HAMPTON YOUNG, M.D.	

## CHAPTER XXI.

SARCOMA OF THE PROSTATE . . . . .	720
By HUGH HAMPTON YOUNG, M.D.	

## CHAPTER XXII.

CALCULUS DISEASE OF THE PROSTATE . . . . .	723
By HUGH HAMPTON YOUNG, M.D.	



# MODERN UROLOGY.

---

## SECTION I.

---

### CHAPTER I.

#### HISTORICAL SKETCH OF GENITO-URINARY SURGERY IN AMERICA.

By F. S. WATSON, M.D.

It is but ten years since genito-urinary surgery, or, as it is usually called today, "urology," has become an established specialty of the medical profession in America. Before that time nearly all who contributed to the advance of knowledge of this branch of surgery were general surgeons.

Previous to 1890 there were but three or four clinics in the country devoted to the care of patients having maladies of the genito-urinary tract.

The first recognition of genito-urinary surgery in the title of a teacher of medicine in this country was that given to Dr. Van Buren, of New York, who, in 1877, held the position of professor of the principles of surgery, with diseases of the genito-urinary system, and clinical surgery in the Bellevue Hospital Medical College (Fig. 1).

Prior to 1877 there was but one treatise in America dealing with the subjects which are included in this field. This was the work of the elder Gross,<sup>11</sup> of Philadelphia, the first edition of which appeared in 1851 and the last in 1876. It was the third work of its kind in the English language at that time, the other two being those of the distinguished English surgeons, Brodie and Coulson.

The contrast offered by the status of genito-urinary surgery today with that which has been indicated above may be seen by the large number of medical men who confine their attention exclusively to the study and care of the diseases of the genito-urinary system; by the recognition of the importance and growth of this special branch by medical schools, in many of which departments with professors at their heads, have been created for the teaching of it; by the organization of several associations for the purpose of discussing

subjects included in urology and of advancing our knowledge of them. Finally, there have been published in the last twenty-two years eleven exhaustive treatises upon diseases of the genito-urinary system, besides many important monographs concerning certain parts of it as compared with the two works which were produced in the course of the preceding forty years.

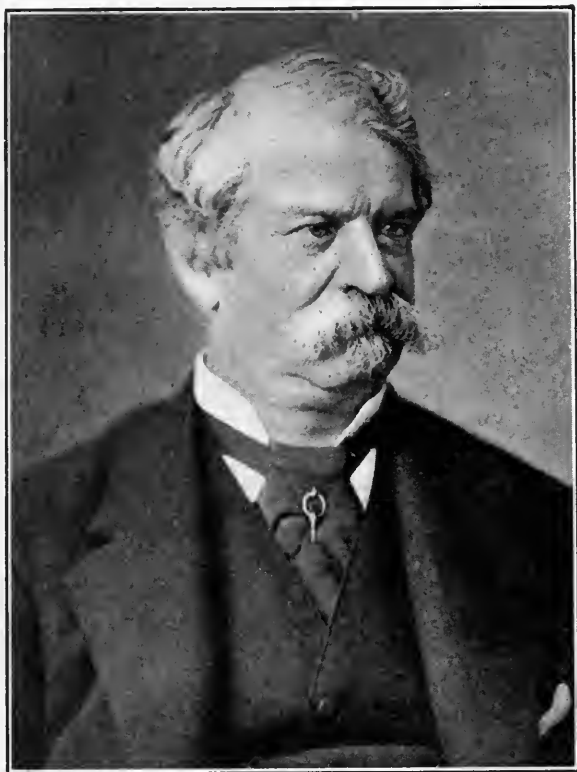


FIG. 1.—Doctor W. H. Van Buren, professor of the principles of surgery, with diseases of the genito-urinary system and clinical surgery, in Bellevue Hospital Medical College, New York.

The data set forth above are evidence that in the wonderful progress which has characterized the growth of surgical science in the last half-century this branch of it has had its full share and kept pace with it.

#### **THE ORGANIZATION OF ASSOCIATIONS OF UROLOGISTS.**

The first association of American urologists, which bore the name of the American Association of Genito-urinary Surgeons, came into being at the home of Dr. Edward L. Keyes, of New York, on the

evening of October 16, 1886. When the organization of the new association was complete, the gentlemen who had been invited to meet there elected Dr. Keyes as its first president.

The list of the original members is as follows:

John H. Brinton, Philadelphia;  
John P. Bryson, St. Louis;  
Arthur T. Cabot, Boston;  
George Chismore, San Francisco;  
Algernon Garnett, Hot Springs;  
Francis B. Greenough, Boston;  
Gilbert C. Greenway, Hot Springs;  
Samuel W. Gross, Philadelphia;  
Moses Gunn, Chicago;  
William H. Hingston, Montreal;  
J. Nevins Hyde, Chicago;  
Edward L. Keyes, New York;  
Claudius Mastin, Mobile;  
Christian Fenger, Chicago;  
Prince A. Morrow, New York;  
Fessenden N. Otis, New York;  
Roswell Park, Buffalo;  
Frank W. Rockwell, Brooklyn;  
Nicholas Senn, Chicago;  
Frederick Sturgis, New York;  
Robert W. Taylor, New York;  
J. William White, Philadelphia.

This association was one of a number which were the component parts of a larger general body, to which the name Association of American Physicians and Surgeons was given, which was formed at about the same time and meets triennially in Washington in congress.

The membership of this special branch of that body was limited to the number of thirty until recently, and it was the intention of its original members to admit into it only those who should have demonstrated unusual ability by their work and who were of high character.

Within the next fourteen years the field of urology had been so greatly extended that a far larger number of men than hitherto had been drawn into it and devoted themselves exclusively to the study of the subjects which are included in it.

Owing to this there was a demand for the formation of another and larger association, and in 1900 the American Urological Association was organized, and has been an active and useful body since that time.

In 1913 a third association of urologists was formed as one branch of the American Medical Association.

In 1907 a few distinguished French surgeons took steps for the organization of an international body of urologists, and in 1908 there

came into existence l'Association Internationale d'Urologie. The most renowned specialist of his time, Professor Felix Guyon, was its first president. The officers of the first congress, which met September 30–October 3, 1908, in Paris, were:

President, Professor J. Albarran. Vice Presidents: Professor Karl Posner, of Berlin; Dr. F. S. Watson, of Boston. Secrétaire-général, Dr. E. Desnos, of Paris. Trésorier-général, Dr. O. Pasteau, of Paris.

A committee composed of Drs. F. S. Watson, of Boston (chairman), John Vanderpoel, of New York (secretary and delegate), and Hugh H. Young, of Baltimore, manages the affairs of the American branch of the international association.

Full recognition of the share that American surgeons have had in contributing to the progress of surgical science in this branch of the profession was given by the members of other countries to America's representatives at the first congress.

*Summary of the More Important Steps of Progress in Genito-urinary Surgery in the Last Forty Years.*—It would seem appropriate to introduce a short statement of steps of progress at this point in the chapter, and therefore those which have occurred during the last forty years or so are briefly summarized below:

1. The revolutionizing of the method of treatment of vesical calculus by the crushing operation—Litholapaxy.

2. Practically speaking, all the knowledge we possess with regard to the nature and treatment of vesical tumors.

3. The radical surgical treatment of the hypertrophied prostate by removal of the gland.

4. The introduction of the cystoscope and the great extension of knowledge secured by its use.

5. The introduction of the ureteral catheter and the opportunity supplied by it to study the functional capability of each kidney separately.

6. Numerous and valuable tests to determine the functional condition of the kidneys.

7. Radiography and the knowledge gained by it, more especially of renal and ureteral calculus, of certain conditions of the kidneys, of the renal pelvis and the ureter.

8. The devising and employment of numerous new surgical procedures and contrivances, among which may be noted:

The operations of nephrolithotomy, nephropexy, operations upon the ureters, partial resection of the bladder, total cystectomy, the removal of vesical diverticula, the operation of prostatectomy, plastic operations upon the penis, urethra, and bladder, the discoveries concerning the normal caliber of the male urethra, the operation of litholapaxy, etc.

Each and all of these have resulted in great saving of human life and sparing of human suffering.

**BRIEF SKETCHES OF SOME OF THE MORE NOTABLE MEN  
IN THE FIELD OF UROLOGY.**

The group of surgeons in whose hands rested the early development of Urology in America, was composed of men of unusually high character and distinction. Among them were some whose work has secured for them international recognition and fame, and has marked them as among the most distinguished medical men of their time.

It has seemed to the writer that greater interest would be lent to this chapter if there should be included in it something of personal reference to a few of the most notable members among the contributors to Urology in this country, and he feels confident that in making the selection of them he will be in accord with the views of the greater number of his colleagues, and that his choice will meet with their approval. The following six surgeons are the subjects of the brief sketches that follow:

SAMUEL D. GROSS, Professor of Surgery in the Jefferson Medical College of Philadelphia.

HENRY J. BIGELOW, Professor of Surgery in the Harvard Medical School of Boston.

EDWARD L. KEYES, Professor of Genito-urinary Surgery, Syphilology and Dermatology in the Bellevue Hospital Medical College of New York.

ARTHUR T. CABOT, Lecturer in Genito-urinary Surgery in the Harvard Medical School, and Fellow of the Corporation of Harvard University, Boston and Cambridge.

JOHN P. BRYSON, of St. Louis.

SAMUEL ALEXANDER, Professor of Genito-urinary Surgery in the Medical School of Cornell University of New York.

**Dr. Samuel D. Gross, of Philadelphia** (Fig. 2).—The elder Gross, as he was usually called, was one of the most distinguished citizens of Pennsylvania as well as the most distinguished surgeon of that State of his or other times. He stood forth from his fellows by virtue of his rare personal attributes, his broad sense of humanity and warm heart, and because he bore the stamp of a master and leader of men.

He was the most authoritative writer on surgical matters in America in his day, the most masterly teacher, one of the most finished operators, and was the highest type of medical practitioner. In character he was absolutely upright, of decided though just temper, and a man of great human kindness.

In an admirable address upon Dr. Gross, delivered some years ago by another distinguished physician of Philadelphia, Dr. John Chalmers Da Costa, many interesting details concerning the elder Gross are recounted. The following quotations are taken from this address:

"Dr. Gross was the most illustrious graduate of Jefferson Medical College. He was the most celebrated man who ever taught there. He was the leading surgical writer of his day. He was among the most notable of the great men of the nineteenth century who really

created the magnificent science of modern surgery, and many of his views influence us still.

"Dr. Gross was tall, well made, and moved with a dignified gait. He had a noble head, a broad, high forehead, and snow-white hair. He was the embodiment of professional and professorial dignity, the beau ideal of a wise and learned surgeon.



FIG. 2.—Dr. Samuel D. Gross, professor of surgery in Jefferson Medical College, Philadelphia.

"As a teacher, Dr. Gross was magnificent. . . . He was animated, profoundly interested in what he was doing, absolutely convincing.

"Now and then he liked to tell an anecdote in order to fix a point in the memory. He used to say: 'A mere statement is a nail driven into a board. A story bends the point of the nail and holds it fast in place.'

"As an operator, Gross was calm, painstaking, careful. He was rapid, but not hurried, and always proceeded so that students might see and understand what he was doing."

Two little incidents are told in the course of Dr. Da Costa's address which throw a side-light upon Dr. Gross's character, and are worthy to be recorded here:

"On one occasion a patient was brought into the clinic and was found to require a small operation on the foot. Gross determined to do it at once. He directed one of the junior assistants to wash the foot. The young man declined to do so, saying that he had not come there to do such work. The professor called for soap and water and scrubbing brushes and did it himself. He dismissed the assistant from his place and told the class that there was nothing dirty in surgery."

"On another occasion he walked into the out-patient department, where a junior assistant was speaking in a very imperative manner to one of the poor patients. Gross said: 'Young man, you speak as one having authority, but the basis of all authority here must be kindness.'"

Dr. Gross left an excellent record of lithotomy operations performed by him. It consisted in 69 operations of lateral lithotomy upon children, with but 2 deaths.

He was a general surgeon, and not in any sense a specialist. Among his other writings, however, is that to which reference has already been made, which treats of the diseases of the urinary organs, and which was for many years the standard authority upon the subjects of which it treats.

In the last edition of this work the elder Gross<sup>11</sup> had the assistance of his son, another surgeon of remarkable attributes, and in that book we find references to some of the subjects which we are wont to regard as being essentially of modern origin—such, for example, as the removal of vesical tumors and partial prostatectomy.

In the chapter on Vesical Tumors in the last edition the methods for their removal are described as avulsion, ligature of the pedicle and excision; curetting, and cutting off with snare, these being done through the dilated female urethra or through a perineal boutonniere in the male.

In the chapter in which the surgical treatment of the hypertrophied prostate is spoken of the following passage occurs (p. 114): "When the obstruction to micturition is complete and the capacity of the bladder is greatly diminished, so that resort to the catheter becomes necessary every hour . . . the permanent retention of a tube in the bladder above the pubes may be advisable to avert impending death. . . . When the obstacle to the passage of urine depends upon enlargement of the middle lobe and the patient is in fair general health, I can see no objection to excising it. . . . I should certainly prefer it, in such an event, to the formation of an artificial fistule above the pubes. In executing the operation the incisions would have to be the same as in the lateral operation of lithotomy, and the enlarged lobe could be easily cut away with probe-pointed bistoury or a pair of probe-pointed stout scissors."

Dr. Gross's activity continued throughout a very long, most valuable, and distinguished career. He held the chair of surgery in no less than four medical colleges in America during his life. He wrote some

of the most important surgical works of his time. He exercised a strong and most beneficial influence upon the profession of this country, and was an example of all that is of the best and highest in the physician. Few men have been held in so high esteem as he. Few have better deserved to be thus regarded.

**Dr. Henry J. Bigelow, of Boston** (Fig. 3).—Of the men who added luster to this special field of surgery, Dr. Henry J. Bigelow, was in the eyes of many of his contemporaries the most striking figure and had the most dominant personality.

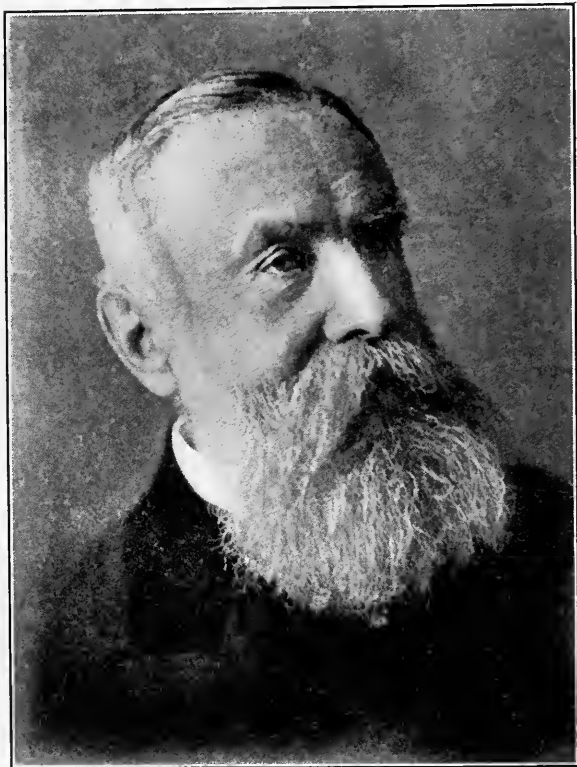


FIG. 3.—Dr. Henry J. Bigelow, professor of surgery, Harvard Medical School, Boston.

His career was one of almost unexampled brilliancy and success. He made the most important single contribution to genito-urinary surgery that has been made in this field. He was vitally instrumental in causing the adoption by the profession of the greatest boon that has perhaps been given to man—anesthesia by the inhalation of sulphuric ether—which was first administered in public by Dr. Morton, of Boston, in 1846, in the amphitheater of the Massachusetts General Hospital to a patient of the elder Warren (Fig. 4).

Dr. Bigelow was at that time a young man, just beginning his professional career. His promotion in the ranks of medical men was

extraordinarily rapid. Two years after he had begun his practice he was appointed visiting surgeon to the Massachusetts General Hospital, and three years later was given the position of professor of surgery in the Medical School of Harvard University.

Much of his medical education was received in France, and he possessed, whether by nature or by his early association with the French people, a large share of their finesse and mental acumen.

His first contributions to surgical literature were published when he had been but two years in practice, and whatever he made public thereafter was of high quality and value.

Dr. Bigelow was tall, handsome, graceful, of polished manners, a thorough man of the world, and a patrician.



FIG. 4.—The first administration of ether in the old amphitheater of the Massachusetts General Hospital, 1846.

If one recalls the gatherings of medical men of one or another of the international medical congresses, those who are most clearly stamped on the memory, among their members, are: Pasteur, Lister, Virchow, von Langenbeck, Bigelow, Sir William Macewen, Sir William MacCormac, and Sir James Paget. All of them truly remarkable, most of them great men. Bigelow was not the least among them.

Bigelow's mental qualities were such as to place him in the class of men we call geniuses. The chief characteristic of his mind was that of seizing with extraordinary rapidity and in unerring fashion upon the vital point of the problem presented to him and of remaining absorbed in it until he had established it to his satisfaction in all its bearings. One might liken the working of his mind to the swift plunge of a fish hawk when it drops into the water and fixes its talons in the submerged prey.

As an operator his coördination of mind and hand were more perfect,

the delicacy, deftness, and precision of movement more remarkable than it has ever been the fortune of the writer to see exhibited by any other surgeon. He added grace and finish to all his work. His hands never made groping motions, but went direct to and from the objects they sought with swift, single movements. His sense of touch was so keen that it often gave him the power to make almost instantaneous and correct diagnoses which other men failed of doing.

As a teacher he was equally remarkable. The value of his lectures was enhanced by his power of graphic, often dramatic and epigrammatic expression, and by a tendency, which may have been in part unconsciously exercised, in part done with intent, to stage in the most telling manner—if one can apply such a phrase to the surgical amphitheater of a hospital—the scene of his operations and teaching.

One little example of his way of summing up a part of a subject may be given as an illustration of the indelible impression which he so often made upon his students. In a lecture upon dislocations of the joints of the arm he concluded his remarks thus: "A great many pages have been written and many illustrations have been made to describe and to represent numerous complicated bandages, apparatuses, or whatever, employed for the purpose of retaining the arm in its proper position after reduction of a dislocation of the shoulder-joint has been effected. The whole thing consists in this: pad in the axilla, elbow to the side, arm in a sling. Good morning, gentlemen."

He would have been as successful in diplomacy, or in a number of other walks of life, had he followed any one of them, as he was in his chosen profession.

He was many-sided and his mind reached out in many directions. As a consequence he became interested from time to time in a number of subjects other than those included in his professional work. Among these outside excursions—if one may so call them—may be mentioned: fancy breeds of pigeons, gems, the restoration of pictures, soil fertilizers, the facial expression of the monkey.

Another anecdote of Dr. Bigelow may be appropriately told here. He was walking through the Boston Art Museum with the curator of the institution. As they passed a small repository in which some of the valuables of the museum were placed for safe keeping, the doctor's eye fell upon its lock. He stopped, and after contemplating it for a moment, turned to the curator and told him that he did not think the lock was safe. The curator did not agree with him. "Very well," said Bigelow, "I'll bet you that I can come down here in the course of the next few days and pick that lock in ten minutes." The wager was taken. A day or two later a visitor calling upon the doctor discovered him seated at his desk with a basket filled with all manner of locks beside him, while locks of various patterns were scattered freely about the room. "What on earth are you doing?" asked the visitor. "Oh," replied the Doctor, "I am merely getting ready to pick one of the locks at the Art Museum."

In the course of the next four days he came to the museum and

picked the lock in two minutes in the presence of the curator. The incident illustrates one of the doctor's mental qualities which was that of becoming absolutely absorbed in the study of a problem until he had reached the solution of it. After having done so he would frequently cast the whole matter aside as though it had never interested him at all. Sometimes he turned over the finishing of the detail of his problem to another, after he had solved the chief point of interest in it; yet no one ever carried detail to more complete and finished consummation than he, if he desired to do so.

He was the author of the most important single contribution that has been made to the field of genito-urinary surgery. This was his operation known as litholapaxy, of which more extended description will be given farther on in this chapter.

On entering the surgical amphitheater Bigelow would sometimes find a colleague who had encountered a check in the course of the performance of an operation, such, for example, as that which is offered at times by the difficulty of finding the posterior end of a ruptured or tightly strictured urethra. Bigelow would watch his colleague's efforts, for a moment, then say to him, "Want to let me have a try at that?" Assent being given, he would take the instrument in his hand, and, presto! the thing was done in one movement.

Nature had gifted him with rare attributes; he developed many of them to a high degree of perfection. Possessed of a mind that was constant in its inquiry into the nature of various phenomena, gifted with clear vision and accurate powers of observation, these qualities being enhanced by a striking power of expression, by an impressive bearing and dominating personality, he stands out in one's memory as the most remarkable figure in the profession of medicine in this country in his day.

**Edward L. Keyes, of New York** (Fig. 5).—One of the admirers and followers of the teachings of Dr. Keyes placed in a treatise which he published, many years after first meeting him, the following inscription as a dedication to the volume: To Edward L. Keyes—surgeon, author, teacher, and master in his field of the profession—the author dedicates this work as a token of his respect and esteem.

Far too brief a summary to address to one of the foremost masters of his day in the medical profession in America.

Dr. Keyes won a conspicuous place in surgery, and especially in urology, at a very early period of his career. He first became known to the medical public as the junior author of a work on *Genito-urinary Diseases and Syphilis*, the senior author of which was Dr. Van Buren, of New York. This work and its succeeding edition, the later ones of which have been the work of the younger Keyes, has held its place as the most popular text-book in this field of surgery from 1874 to the present time.

The chapters on Calculus in the first edition were the work of Dr. Van Buren, the rest of the volume being entirely written by Keyes. In a private letter to the writer, Dr. Keyes says that Dr.

Van Buren revised the whole work, and speaks in terms of highest praise and with warm gratitude of his own indebtedness to his senior associate who was a widely known surgeon in New York.

Dr. Keyes had scarcely started in the practice of his profession when he undertook this work, and it is a great tribute to his powers. The work is remarkable for its direct, terse, lucid style and for the practical manner in which the subjects are treated, thus giving to it an especial value to the students of medicine.

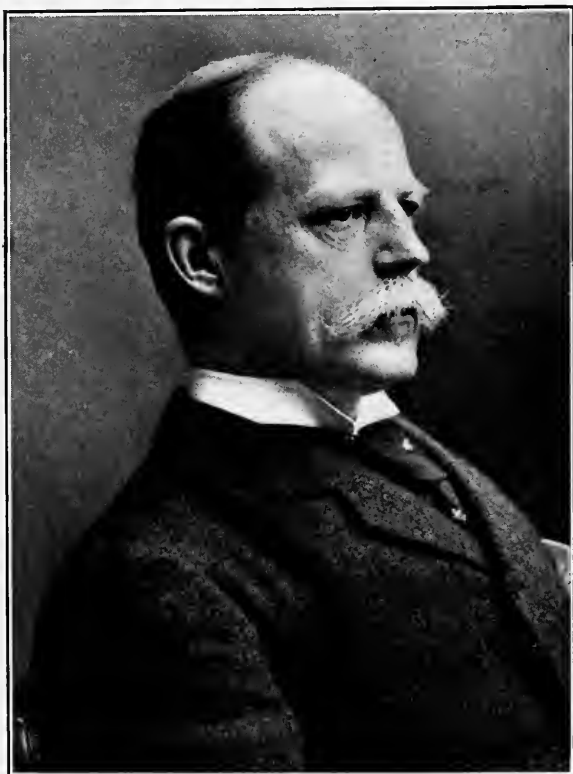


FIG. 5.—Dr. Edward L. Keyes, professor of genito-urinary surgery, syphilography, and dermatology in the Bellevue Hospital Medical College, New York.

For more than twenty-five years Dr. Keyes was the highest authority in what we call an “all-round” sense, in this country, in the field of urology. He was not, however, a specialist, but a general surgeon.

Dr. Keyes was a teacher of rare power, and the writer well remembers the strong impression made upon him by his teaching when he had the good fortune to hear his lectures during a winter passed in New York many years ago. He presented his subject in a terse, forceful, and practical manner, and caught and absolutely held the attention of his students as few teachers are able to do.

He was masterful, a natural leader of men, filled with a super-

abundant energy, capable of doing an enormous amount of work day in and day out.

One recognized in Dr. Keyes at first glance the integrity, directness, and honesty of the man, and saw a look of determination that was an index of character that must have meant much in the building of his successful career.

His influence and his work have been of great value to surgical science and to his colleagues, and have won for him universal respect and esteem most well deserved.

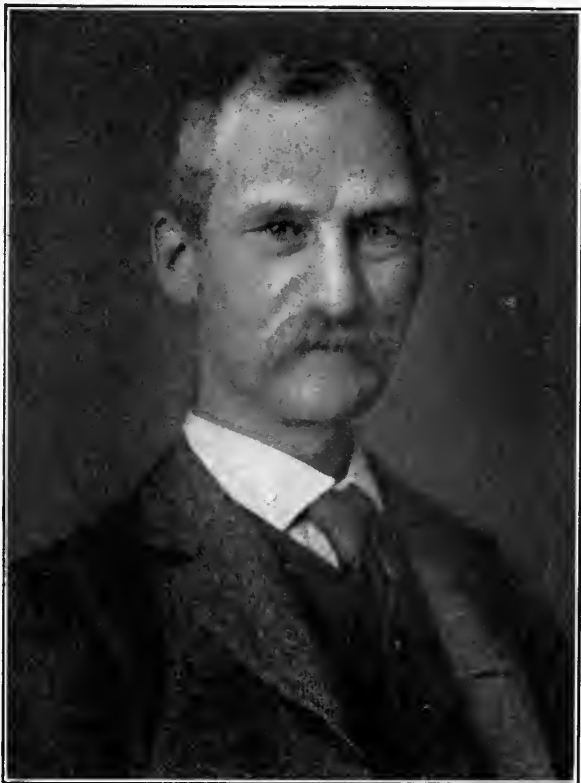


FIG. 6.—Dr. Arthur T. Cabot, instructor in genito-urinary surgery, Harvard Medical School, Fellow of the Corporation of Harvard University, Boston.

**Dr. Arthur T. Cabot, of Boston (Fig. 6), and Dr. John P. Bryson, of St. Louis.**—One instinctively associates these two men in one's memory because of their having possessed certain sterling and high qualities in common and because of the nobility and manliness of their characters. No one possessing mean, dishonest, or underhand traits of human nature, it may be believed, ever came into the presence of either without being conscious of a rebuke to those qualities. Both stood for what they believed to be right, and were uncompromising in advocating it and in condemning what they believed to be wrong.

The value of their service was greater by virtue of their character as men rather than for the originality of the work which they contributed to this field of the profession. Few, if any, medical men exercised a stronger influence for good in their profession than these two. With Dr. Cabot its effect reached far beyond his profession, indeed, for he rendered distinguished service in other fields of public work as well. His most notable services of this kind were those rendered by him in his positions as a member of the corporation of Harvard University, as trustee of the Boston Art Museum, and as chairman of the board that was organized to limit the spread of tuberculosis in the United States.

In these offices as well as in those of teacher in the medical school of Harvard University for several years, as visiting surgeon to the Massachusetts General Hospital, and as one of the best practitioners of medicine in his town, he rendered great public service, and the value of all of it was enhanced by the fact of his being a thorough gentleman and high-minded man.

The first recognition of urology as a special department of the medical profession given by Harvard University was in its appointment of Dr. Cabot as an instructor in genito-urinary surgery in the Medical School of Harvard in the year 1880.

As an operator, Dr. Cabot was careful, deliberate, calm, thorough; as a surgeon, he was wise and conscientious; as a man, humane, upright, straightforward and honorable. His temper was sharp but just.

Apart from his profession and the public works already mentioned, he displayed unusual capabilities in his diversions, for he was as an amateur an uncommonly good painter of pictures in water color, and a very keen and admirable sportsman. He was one of the best shots in the community. He was fond of the country and of animals, a good cross-country rider, and a polo player. These were his principal diversions, and he enjoyed them and exhibited in them a capability of character similar to that displayed in his professional work.

**John P. Bryson, of St. Louis.**—An exponent of manliness and honesty! These are the qualities of which one first thinks when recalling Dr. Bryson and his work. The first of them was put to the test, and doubtless fortified, when, at the age of seventeen, as a private soldier in the army of the South, during the Civil War in America, he was in the thickest of the fighting in the two days' battle at Gettysburg. It was a rough initiation to life that he received on that field, but it stood him in good stead throughout a most useful and valuable life, in which all his efforts were directed to relieving human suffering.

Reliable, strong, and honorable—always dealing telling blows for good causes, and always ranging himself against all that was less worthy in human nature, warm of heart and of tender humanity. He, too, exercised a strong and beneficent influence in his profession. Dr. Bryson was a general surgeon, though in the later years of his life he was identified chiefly with the field of genito-urinary surgery, and

for a number of years contributed to it work of high, though not strikingly original, character.

**Dr. Samuel Alexander, of New York (Fig. 7).**—A man possessed essentially of the temperament and nature of a genius, one who unaided by the physical traits that often play so important a part in the effect produced by certain men, none the less dominated in remarkable degree those who came in contact with him. His nature, his manner and speech may be designated without exaggeration as fervid. His enthusiasm for his work, for his teaching, in his researches, was hot and seemingly



FIG. 7.—Dr. Samuel Alexander.

inexhaustible; moreover it was contagious, and owing to this he was a teacher who, so to speak, gripped his students by the throat. He held them in closest attention and inspired them with his own enthusiasm more perhaps than any other teacher of his day. As a lecturer he was rapid of speech, vitalized to the finger-tips, lost in his subject, oblivious of self; intent only on lodging the information which he desired to impart in the minds of his listeners, and succeeding in so doing as it is given to but few men to succeed.

Dr. Alexander was not a general surgeon, and is the only one of

those of whom these short sketches have been written who was definitely a specialist, for he confined his work entirely to genito-urinary surgery and syphilis. His mind was of a distinctly original quality, although the actual original work that he produced was not so much in amount as he doubtless would have contributed but for his early death, and being hampered for several years by serious illness. His contributions to genito-urinary surgery were, however, all of them, of distinctive character, and all of them marked by original expression and thought. They were always thorough, carefully prepared, beautifully illustrated, and presented without thought of any personal advantage that might be derived from them. He was more notable as a teacher than as an operator, though he did not lack skill in that capacity.

It was doubtless true of the other members of the association, to which the writer and Alexander both belonged, that they looked forward, as he did, to meeting Alexander at each of its annual gatherings with greater pleasure than was anticipated from any other feature of them. He was an excellent fighter, hit hard and straight, never skirmished for a technical advantage in a discussion, but fought vigorously to establish his views, always in the open. It was delightful to become involved in a good hot discussion with Sam: Alexander.

The following sketch of Dr. Francis S. Watson is written by Dr. Edward L. Keyes, Jr., of New York, at the request of the editor of this work, who desires to include its subject in this chapter:

"Among the circle of men who have maintained the high standard of urology in Boston during the past forty years, Dr. Francis S. Watson is unique (Fig. 8).

"As a pupil of Bigelow, he inherited the best traditions. As surgeon of the Boston City Hospital, he cultivated his inheritance. As the author of many monographs upon urological topics, he evinces his lucidity of thought and keenness of observation. But in his case, as in that of all memorable men, the peculiar force of his personality is what stands foremost in the memory of those who know him. To say that his wit is as lucid as his intelligence, or that his tireless energy drives both to incessant display, suggests only the most salient of his characteristics, mellowed as these are by a great gentleness and intense feeling for art and music, and above all a whole-hearted and generous love and loyalty for his fellows.

"As an informal teacher (for we can speak with no knowledge of his work with the undergraduates) at medical societies and elsewhere such a personality scintillates with suggestions; even more perhaps in its *obiter dicta* than in the direct topic. This casual brilliancy is permanently illustrated in that work which he would be the last to wish placed at the head of his achievements, a three-act travesty on medical foibles and New England rusticity, entitled 'A Day with the Specialists.'

"But to turn from the gay to the grave, his important contributions to medical literature are numerous.

"In 1888 he published a volume entitled *Operative Treatment of the Hypertrophied Prostate*, which both by its textual and its pictorial illustrations of pathological conditions has been the foundation for much subsequent work.

"He performed his first perineal prostatectomy in the following year. This was apparently the first time that the operation was performed in America.



FIG. 8.—Dr. Francis S. Watson, lecturer on genito-urinary surgery, Harvard Medical School, Boston.

"Among his more recent contributions we may mention his original method of nephropexy, described in the *Boston Medical and Surgical Journal*, July, 1896.

"An exhaustive study of Subparietal Injuries of the Kidney, *Boston Medical and Surgical Journal*, July 9 et seq., 1903.

"Operative Treatment of the Hypertrophied Prostate (*Annals of Surgery*, June, 1904) and his contributions to the subject of vesical tumors, *Annals of Surgery*, 1905 and 1907, reviewing the disastrous surgical history of this condition, and urging bilateral preliminary nephrostomy followed by total cystectomy for certain cases of malignant neoplasms.

"In 1909 he urged unilateral nephrolithotomy in the treatment of

certain cases of calculous anuria before the International Urological Congress, of which he has been vice-president since the inception of the International Association of Urology, and the bilateral operation in a small class of other cases of the same condition.

"The summing up of Dr. Watson's literary contributions and surgical experience is a two-volume work on genito-urinary surgery, written with the assistance of Dr. John H. Cunningham, Jr., and published by Lea & Febiger in 1908. This will long stand as a monument to the genius of its author."

### THE EVOLUTION OF UROLOGY IN AMERICA.

The year 1851 is selected as that in which the specialty of genito-urinary surgery had its birth in this country, because it was in that year that the elder Gross published his work dealing with the maladies of the urinary organs. This was the first work of this character in America, and the third one in the English language, the other two being the treatises of the noted English surgeons, Brodie and Coulson.

From 1851 until 1877 the treatise of Gross was the only one available to students of this special branch of surgery in this country. It had great literary value and, so far as it went, was a full and thorough exposition of the subjects of which it treated. It held its place in medical literature and in the world of medical students until the year 1876, when its last edition appeared.

In 1877 the first edition of its rival and successor, the work of Van Buren and Keyes, already referred to, was published, and before long superseded its predecessor.

Mention has been made of the comparatively large number of exhaustive treatises upon genito-urinary surgery and venereal diseases which have appeared since 1879, and they may be appropriately named at this point as follows:

- 1880. Otis: *Stricture of the Urethra*.
- 1893. P. A. Morrow: *System of Genito-urinary Diseases and Syphilis*.
- 1895. White and Martin: *Genito-urinary and Venereal Diseases*.
- 1898. Bangs and Hardaway: *American Text-book of Genito-urinary Diseases, etc.*
- 1900. Fuller: *Diseases of the Genito-urinary System*.
- 1902. Morton: *Genito-urinary Diseases and Syphilis*.
- 1905. Deaver: *Monograph on the Prostate*.
- 1907. Greene and Brooks: *Diseases of the Genito-urinary Organs and Kidneys*.
- 1908. Watson and Cunningham: *Diseases and Surgery of the Genito-urinary System*.
- 1910. New Edition of Keyes. Written by Edward L. Keyes, Jr.
- 1910. Part of Keen's *Surgery on Genito-urinary Diseases*.
- 1912. Guiteras: *Urology*.
- 1912. Garceau: *Monograph on Tumors of the Kidney*.
- 1913. Chetwood: *Practice of Urology*.

Translation by Bonney of the work of Casper, of Berlin, 1910.

The work of Bumstead and of Taylor, of New York, are not included in this list, as they deal only with venereal disease.

In general, it may be said that all of these works are of high merit and of great value.

In addition to them there have been published many important and admirable monographs upon special subjects included in the field of urology.

### CONTRIBUTIONS OF AMERICAN SURGEONS TO UROLOGY.

The members of the medical profession whose works are cited in this sketch are, with three or four exceptions, those who are no longer living or who have retired from active participation in the work of their profession.

The author of this chapter recognizes that in thus limiting its personal history he does not render full justice to the part that American surgeons have taken in the advancement of knowledge of Genito-urinary Surgery, but he has been advised to follow this plan by those having the publication in hand, and as he thinks, wisely advised. He trusts to be excused for having made the obvious omissions of important work done by his colleagues who are still among the active workers in the profession, and believes that they will readily forgive his failure to give them mention.

Among those whose works receive notice below there are three still living: Drs. W. H. S. Gouley and Edward L. Keyes, Jr., of New York, and Francis S. Watson, of Boston. The names of those who have died are as follows:

John Ashhurst, Jr., Philadelphia.  
 Samuel Alexander, New York.  
 Henry J. Bigelow, Boston.  
 L. Bolton Bangs, New York.  
 Tilden Browne, New York.  
 Dr. Byford, Chicago.  
 John P. Bryson, St. Louis.  
 Arthur T. Cabot, Boston.  
 George Chismore, San Francisco.  
 George M. Edebohls, New York.  
 Dr. Gilmore.  
 William Ingalls, Boston.  
 A. Jackson, Chicago.  
 Fessenden N. Otis, New York.  
 Dr. Peasely, New York.  
 Dr. Pyle.  
 Dr. Peters, New York.  
 Alex. Stein, New York.  
 Robert Taylor, New York.  
 Robert Weir, New York.  
 J. William White, Philadelphia.

## RENAL SURGERY IN AMERICA.

**Nephrectomy. Transperitoneal.**—The first performance of the operation of nephrectomy is credited by Albarran to the American surgeon Walcott in 1861. The operation was transperitoneal. The patient was a woman, aged fifty-eight years. She had cancer of the kidney. She succumbed on the fifteenth day following the operation.

*Peasely.*—The second nephrectomy, also a transperitoneal operation, was done by an American surgeon in 1868. The patient was believed to have an ovarian tumor, and the operation was undertaken under that impression. The tumor was found to have its seat in the kidney, and that organ was removed, together with the neoplasm. This patient also died.

*Gilmore* performed, in 1870, one of the earliest nephrectomies, and his patient recovered. This, too, was a transperitoneal operation. The patient was a woman who was five months pregnant.

*Peters*, of New York, in 1872, did another nephrectomy, the patient in this case dying subsequent to it.

*Byford*, of Chicago, in 1878, performed the first successful nephrectomy in a case of cancer of the kidney. This operation was also a *transperitoneal one*. The patient recovered.

The first *lumbar nephrectomy* was, as is well known, done by Simon, of Heidelberg, in 1869. The patient recovered. The same operation was done by the same surgeon again in 1871. This patient died. The first nephrectomy in England was done by Durham in 1872. The first one in France by Le Fort in 1880.

**Nephrolithotomy.**—The first performance of the operation of nephrolithotomy is of uncertain date. Dr. Desnos, of Paris, in a recent and admirable historical chapter written as a part of the *Encyclopedie Française d'Urologie*, quotes from the Memoire of Hevin, in which it is stated that this operation was performed, in 1633, by a surgeon named Domonique Marchettis, the patient being an English consul. The patient insisted upon having the operation done.

The procedure was carried out in two stages, the kidney being exposed on one day and entered on the second one. Three small calculi were extracted from its interior and a fourth one was passed spontaneously into the dressings later. The latter is said to have been the size of a date stone. The patient suffered the inconvenience of having a permanent renal fistula, but recovered.

A similar operation is said to have been done by Lafite in 1734. The operation thereafter was condemned and passed out of sight for more than one hundred years.

In modern times one of the first, if not the first, surgeon to do this was an American.

*William Ingalls*, of Boston.—Dr. Ingalls, a member of the surgical staff of the Boston City Hospital, removed a large calculus from one of the kidneys of a woman by a lumbar operation which he had deliber-

ately planned. The operation was done October 8, 1872. It was not reported until 1882.<sup>13</sup> In consequence of this delay the English surgeon Mr. Morris received the credit of being the originator of the procedure in modern times. He published his first cases in 1881.

**Nephropexy.**—The operation of attaching the kidney to the loin in cases in which the organ has an abnormal mobility and more or less serious symptoms are being produced by it originated with the German surgeon Hahn in 1881. Hahn's operation was inadequate, and it was not until the following year, 1882, that Bassini for the first time passed sutures through the capsula vera of the kidney for the purpose of fixing it to the posterior wall of the abdomen.



FIG. 9.—Edebohls's modification of the operation of nephropexy. (Watson and Cunningham.)

*Robert Weir*, of New York (1882).—The method employed by Bassini was also carried out by Weir, of New York, in the same year (1882). This operation, so far as we can learn, was the first nephropexy performed in America.

Numerous modifications of the technic of the operation have been introduced since that time. Among them are two by American surgeons. The first of these is that of

*Edebohls*, of New York (Fig. 9).—In this method of doing the operation the kidney is decapsulated and the sutures are applied on either side of the organ through the fibrous capsule which they traverse twice in order to give a more firm holding ground for the stitches.

*F. S. Watson*, of Boston (Fig. 10).—In the method devised by Watson the sutures are passed, four in number, through the substance of the kidney, two in the long, and two in the transverse axis of the organ. The capsule is split through the length of the posterior border of the kidney.

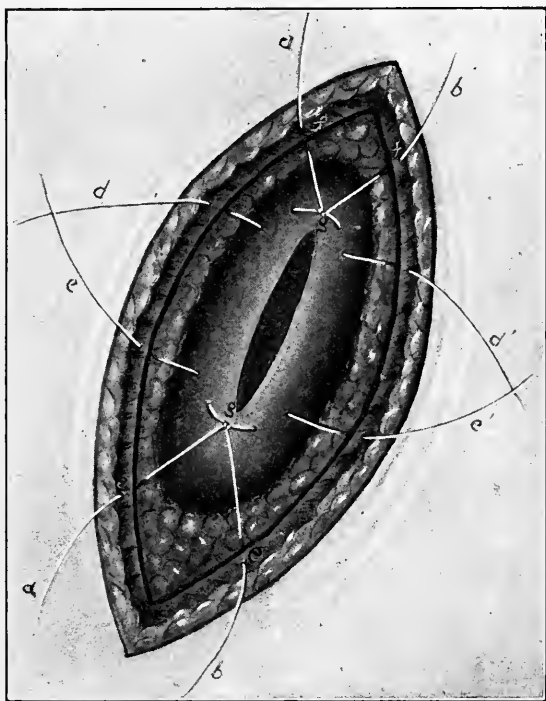


FIG. 10.—Watson's modification of the operation of nephropexy. (Watson and Cunningham.)

*Bilateral Nephrolithotomy at one Sitting in Certain Cases of Obstructive Anuria.*

*F. S. Watson*, of Boston, at the first Congress of l'Association Internationale d'Urologie, held in Paris, in October, 1908, made, as one of the reporters on the subject of anuria, a plea for the employment of bilateral nephrolithotomy, or ureterolithotomy, at one sitting in certain cases of calculous anuria. The communication forms a part of the reports of that congress issued in Paris during the same year.

*Edward L. Keyes*, of New York (*New York Medical Journal*, June 16, 1894).—In this number of the journal is a valuable communication made by Dr. Edward L. Keyes, of New York, on the subject of nephritis in its surgical aspects.

## SURGERY OF THE BLADDER.

**Vesical Calculus.**—*Henry J. Bigelow.*<sup>3</sup>—*Litholapaxy*, 1878.—The most noticeable achievement of an American surgeon in the field of urology is that to which its author gave the name of litholapaxy, intending thereby to indicate an operation for crushing vesical calculus and entirely removing it from the bladder in one and the same sitting. The first account of Dr. Bigelow's method was published in the *American Journal of the Medical Sciences* in 1878. Dr. Bigelow subsequently demonstrated it before the International Medical Congress in London in 1881.

Before the introduction of the operation of litholapaxy the method employed when treating vesical calculus by the crushing operation of lithotrity was to crush the calculus for as short a time as possible and to leave the resulting fragments to be passed out by the natural acts of micturition. The calculus was finally disposed of by a series of successive crushings varying in number according to the size and hardness of the stone. Five minutes was the longest time which was thought to be safe to continue the crushing procedure at any one sitting.

The operative mortality at the best—as, for example, that which occurred in the hands of the most skilful lithotritist of his day, Sir Henry Thompson, of London—was nearly 6 per cent., while in the hands of less adroit operators it was nearly 10 per cent., and in the case of patients having prostatic obstructive conditions it rose to 15 per cent., and even higher.

Bigelow based his operation of litholapaxy upon the belief that the bladder would tolerate far better even the prolonged manipulations in it of smooth round-ended instruments than the irritation produced by fragments of calculus left in it at a series of successive sittings. If he were correct in this supposition, and if the means could be devised for emptying the bladder entirely of fragments immediately the stone had been crushed, the operative mortality should be greatly lessened. There remained, in order to test his theory, therefore, the devising of the instruments and apparatus by which these things could be accomplished.

The discoveries of Otis already described, with respect to the large size of the normal male urethra, had opened the way for Bigelow to devise instruments of greater power for the crushing of vesical calculi and for the making of tubes to evacuate the fragments of stone rapidly and effectually. Availing himself of the discoveries of Otis, Bigelow devised a lithotrite of novel form and greater power than was possessed by the instruments then in use, and contrived an apparatus of most cleverly planned and beautifully executed character for evacuating the fragments.

The special features of Bigelow's lithotrite are as follows: (1) The form given to the tip of the female blade which is such as to permit it to pass over obstructions offered by an hypertrophied prostate more



FIG. 11.—Bigelow's evacuating apparatus. (Watson and Cunningham.)

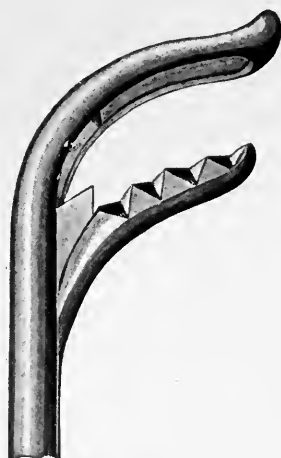


FIG. 12.—Jaws of Dr. Bigelow's lithotrite. (Watson and Cunningham.)

readily than any other. (2) The form given to the distal or crushing end of the male blade of the instrument, which is that of a series of



FIG. 13.—Handle of Bigelow's lithotrite, showing locking mechanism by which the blades are locked upon the stone or released from it.

diverging planes which prevent the blades from becoming clogged with the débris of the calculus during the crushing of it (Fig. 12). (3) The

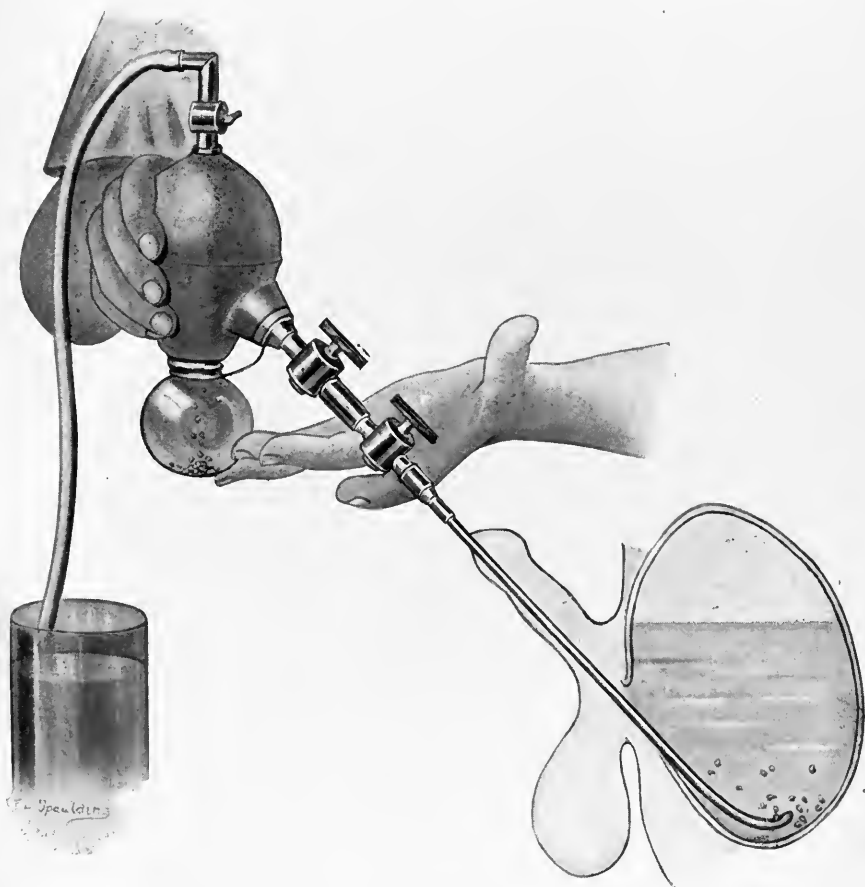


FIG. 14.—Bigelow's evacuating apparatus withdrawing fragments of calculus from the bladder. (Watson and Cunningham.)

mechanism of the handle of the instrument which is such as to avoid the necessity of changing the operator's hands when he has caught the

calculus and desires to crush it (Fig 13). This was necessary with the previously constructed lithotrites, and the innovation of Bigelow in this detail was of great value. (4) Greater strength given to the blades; this is such as to make it impossible to break them, no matter how hard they are screwed together upon the stone.

The features of the evacuating apparatus are the following: (1) The placing of the glass trap below the bulb and in such a way that the fragments of the stone which have once entered it cannot be washed out of it again by the returning current of water into the bladder. (2) The large caliber of the tubes and the location and large size of the eyes of them at their distal ends. Also the raised lip on the posterior end of the eye which prevents the slipping past it of the fragments which are drawn toward it by the current of water that sets them in motion. (3) The straight as well as the curved form of tube, the former permitting, when it can be introduced into the bladder, a more rapid evacuation of the fragments than does the curved tube. The caliber of the tubes is 28 and 30 of the Charriere scale (Figs. 11 and 14).

A comparatively short time of its employment was enough to make abundantly clear that the conception of the author of this new operation had been absolutely correct. The operative mortality grew at once markedly less with its adoption and the abandonment of the former practice of successive sittings.

A glance at the records of this operation and at those of the method of performing lithotritry previously and also of the results of the cutting operations at once demonstrates the superiority of litholapaxy, even in the case of children who were the most favorable subjects for the lateral lithotomy operation.

Two series of American surgeons may be taken as examples of this fact. They are those of Drs. Edward L. Keyes and of Arthur T. Cabot.

Edward L. Keyes's series of litholapaxy operations: Number of cases, 157. Operative deaths, 7. Recurrences, 25. In none of the fatal cases was the patient less than fifty-eight years of age.

Arthur T. Cabot's series of litholapaxy operations: Number of cases, 179. Operative mortality, 4.3 per cent. Recurrences, 21. In none of the fatal cases was the age of the patient less than sixty years. In four of them the ages of the patients were eighty-four, seventy, seventy, and seventy years respectively.

A glance at the large number of cases and the results of the different methods of operation will give a just idea of the relative value of Bigelow's operation as compared with other methods. Operative mortality of lithotritry prior to the introduction of Bigelow's operation of litholapaxy: In elderly people, from 15 per cent. to 20 per cent. In patients aged less than fifty years, about 9 per cent. to 10 per cent.

The following statistics are taken from Watson and Cunningham's *Diseases and Surgery of the Genito-urinary System*, 1908.

*Litholapaxy Operations.*—Number of cases, 17,736. Operative mortality, 2.4 per cent. Patients of all ages. In 2518 patients under fifteen years of age the operative mortality was 1.7 per cent. In 719

patients between fifteen and fifty years of age it was 1.6 per cent. In 2395 patients over fifty years of age it was 4.04 per cent.

*Lateral Lithotomy.*—Number of cases, 11,963. Irrespective of age, operative mortality was 9.8 per cent. In 94 patients over fifty years of age it was 20.2 per cent.

*Suprapubic Lithotomy.*—Number of cases, 3302. Operative mortality, irrespective of age, was 13.2 per cent. In 378 patients over fifty years of age it was 25.4 per cent.

These figures speak too strongly of the value of Bigelow's method of treatment to require comment.

There are several factors, however, which militate against the employment of litholapaxy today which did not oppose its use at the time of its introduction. These are: (1) The marked lessening of the operative mortality of the suprapubic lithotomy operation as compared with former times. (2) The establishment of the operations of total prostatectomy which allow the surgeon to remove the stone from the bladder when there is one present at the same time that the prostate is taken away, and thereby there is secured the freedom of obstruction to the escape of urine and also the freedom from recurrence of calculus. Finally, there is the fact that many surgeons cannot or do not acquire the delicacy and skill which are requisite for the successful performance of litholapaxy.

**Transperitoneal Partial Resection of the Bladder.**—*Dr. Frank Harrington*, of Boston. This method of treatment in certain cases of disease of the bladder was first practised by Rydygier in 1887. In 1893 Harrington first performed the operation in America. It was but little employed until revived by the Mayos and Judd in the famous clinic of the Mayo brothers in Rochester, who have used the procedure in a number of cases of vesical tumors, and with marked success.

**Vesical Tumors.**—The date of the first operation performed for the removal of a vesical tumor is somewhat uncertain. The earliest mention that has been found of such an operation is that performed in 1635 by Covillard.<sup>4</sup> In this case it is doubtful whether or not the tumor removed was a lobe of an hypertrophied prostate. In 1750 Warner removed through the female urethra a large polyp of the bladder. The patient made a perfect recovery.

In 1890 the most complete exposition of the subject of vesical tumors that has up to the present time been published was written by the most brilliant surgeon of France in the field of genito-urinary surgery, Professor Albarran, in his classic work, *Tumeurs de la Vessie*.

In America the first important monograph is that published by:

*Alex. W. Stein*, of New York.<sup>20</sup>—In this volume there are set forth among much else that is of interest the cases of vesical tumor in which operations had been done prior to that time.

*Watson*, of Boston, 1884.<sup>24</sup>—Watson published an article on the subject of vesical tumors in which he added 10 cases to those collected by Stein and reported 1 in which he had operated through the perineal boutonnière.

The earliest operations published in America were the following:

*A. R. Jackson*, of Chicago.<sup>14</sup>

*Ashhurst*, of Philadelphia.<sup>2</sup>

*Ransohoff*, of Cincinnati.

*Watson*, of Boston.<sup>25</sup>

Jackson's case has some unusual features, and seems worthy of special notice. While visiting a female patient one day he found a fleshy mass protruding from her urethra. As he was examining it it was withdrawn into the bladder. Jackson directed the patient's husband to watch for its reappearance, and told him should it again be protruded to seize it with a pair of forceps and hold it until he—the doctor—should arrive. During the absence of the surgeon the tumor was again pushed into view through the urethra. The husband in his eagerness to observe the doctor's orders seized upon it too forcibly and tore a part of it off. The piece that was thus removed was of the size and shape of the forefinger.

Subsequently the surgeon arrived and dilated the urethra. This enabled him to reach and extract, by avulsion, a second portion of a fleshy mass eight inches in length and of considerable thickness. The patient made an excellent recovery, was freed from her former symptoms, and reported that there had been no return of them one year after the performance of the operation.

**Total Cystectomy** (1887–1915).—The first operation for total removal of the urinary bladder was performed in 1887 by Bardenheuer. The patient did not survive. In 1888 the first successful operation of the kind was done by Pawlik, of Vienna, in the case of a woman having vesical carcinoma. This patient survived and was free from recurrence during the ensuing fifteen years or more.

From 1887 to the present time—1915—there have been approximately 80 total cystectomies reported in cases of vesical tumor. The operative mortality of this series is about 40.5 per cent. The operative mortality prior to 1909 was over 50 per cent. The number of cases then reported was approximately 60. In the last twenty operations performed since then there has been a striking diminution of the operative mortality, which is sufficient to have reduced it for the total number of the cases to 40.5 per cent. in place of 50 per cent.

**Ureteral Implantation.**—Until 1895 the ureters were either implanted in the rectum, in the vagina, or abandoned in the wound; and with but two or three exceptions this was the practice until 1905. In 1895 Vasilief seems to have been the first surgeon to make an implantation of the ureters to the skin in connection with the operation of total cystectomy. This patient recovered.

In 1905 Watson, of Boston,<sup>23</sup> proposed a radical change in the method of performing total cystectomy in cases of vesical tumor. Previous to that time it was almost the invariable custom to implant the ureters in one or the other of the locations mentioned above, and to do this at the same time as that at which the bladder was removed.

Study of the causes of the remarkably high mortality attending this



FIG. 15.—Cup-shaped hard-rubber shield of Watson's apparatus for permanent renal drainage through the loin. (Watson and Cunningham.)



FIG. 16.—The various parts of the apparatus. (Watson and Cunningham.)

operation led Watson to the conviction that it was due to three factors, these being: (1) Shock produced by the prolongation of the operation, rendered necessary if the urine was to be diverted at the same time at which the bladder was removed. (2) Renal infection due chiefly to implanting the ureters in the bowel or vagina, but though in far less degree, liable to be invited if the ureters were implanted on the surface. (3) Delaying the operation until the patient's powers of resistance were lowered too far to permit them to sustain its effects and until there was every probability that metastases had already occurred.



FIG. 17.—Watson's apparatus for permanent drainage of the kidney, showing manner of wearing it. (Watson and Cunningham.)

He therefore proposed that: (1) Ureteral implantation in all its forms be abandoned. (2) That the operation be applied to those patients only in whom malignant disease of the bladder had not advanced to a late stage, but was in its early development, and in whom the powers of resistance were still good. (3) Above all, he proposed that the operation of total cystectomy be divided into two stages, the first of which should deal with the diverting of the urinary secretion into its new channel *and that step alone*, for accomplishing which he stated his preference for bilateral nephrostomy as the

preliminary step; and that the second operation should be the removal of the bladder at whatever time it might be appropriate to perform it.

He further described and illustrated in the *Annals of Surgery*, September, 1907, an apparatus designed by him for the purpose of keeping a patient with bilateral renal fistulæ in the loins dry and allowing him to pursue an active life while wearing it. (Figs. 15, 16 and 17.) In this article is the report of a case in which one of his patients has worn such an apparatus with entire comfort during seventeen years, and has been actively at work during the whole time and in excellent condition, draining all the urine from both kidneys into the reservoirs direct through nephrostomy channels.

In only one instance known to the writer has the plan above described been adopted exactly as it was set forth in 1905, for almost all who have done the operation have employed ureterostomy. But there have been a number of cases reported in which the operation has been done in accordance with the most important feature of that plan, namely, the two-stage operation; and so far as the writer has learned, there has been no operative death in any of them. It would therefore appear that his claim that the operative mortality would be markedly lessened, if his proposal were adopted, had been justified.

### SURGERY OF THE PROSTATE.

The share that America has had in developing the surgery of the prostate has been a large one, and it was in this country that it was kept alive during a short interval in which it had been abandoned elsewhere in the world. The first total prostatectomy done through the perineal approach was performed in America. The suprapubic operation of prostatectomy also had its origin in America almost simultaneously with its birth in England, and some of the best modifications of the perineal operation have originated here. Some of the earliest writings upon the operative treatment of the hypertrophied prostate are by American surgeons; later, some of the most important monographs upon the surgery of the prostate were published by Americans.

**Development of the Surgical Treatment of the Hypertrophied Prostate.**—The earliest instances of operations by which parts of the obstructing prostate were removed were those in which they were taken away either accidentally or incidentally to lithotomy operations. The first intentional attempts to overcome this obstruction to the exit of urine from the bladder were made in a few cases by tunneling or cutting through the median lobe of the enlarged gland. Among these may be cited, as examples, the operations of John Hunter, in 1805, of Sir Everard Home in 1835, and of Brodie in 1865. In 1830 Chopart cut through the median lobe with a sharp-pointed lance blade passed through a catheter with an open distal end. In 1795 and in 1806 Dessault and Sir William Blizard respectively removed a median lobe and a lateral lobe in the course of lateral lithotomy operations.

Sir William Ferguson,<sup>5</sup> in the London *Lancet*, January 1, 1870, makes the following interesting comment upon the removal of the prostate: "I have ventured to put on record what some of my professional brethren may have hesitated to do for fear that they may have been guilty in performing their operations of perpetrating some rough mechanism not in accord with the nicety of manipulation which is thought so essential in the performance of the master handiwork of surgery—lithotomy." This remark of Ferguson was applied to his proposal to remove the obstructing parts of an enlarged prostate in the course of the operation of lateral lithotomy.

Amussat removed a mass from the prostate when doing a suprapubic lithotomy in 1830.

In 1830 Guthrie<sup>11</sup> definitely proposed division of the bar at the neck of the bladder.

In 1856 the operative treatment of the hypertrophied prostate was definitely begun by the French surgeon Mercier.<sup>16</sup>

Mercier urged the adoption of the operations of division of the bar at the neck of the bladder and of obstructing median lobes, or the removal of the obstruction to urination by punching out a piece of the median lobe by means of instruments, devised especially for the purpose by him, and which he passed through the whole length of the urethra.

W. H. S. Gouley,<sup>9</sup> of New York (1873).—The operative treatment of the hypertrophied prostate began in America with Gouley, of New York. In 1881 the writer of this sketch had several talks with him, during which Gouley showed him specimens of parts or the whole median lobes of enlarged prostates which he had removed by an operation which was a modification of that of Mercier, whose pupil Gouley had been. The modification consisted in applying the method of Mercier through a perineal boutonnière incision instead of through the whole length of the urethra.

More important yet, however, was Gouley's description of the operation of perineal median total endo-urethral finger enucleation prostatectomy which he sets forth in his work entitled *Diseases of the Urinary Organs*,<sup>9</sup> as follows (he has been describing partial prostatectomy through a boutonnière incision in the urethra): "The surgeon should endeavor to give permanent relief by a procedure which will not add materially to the dangers of the preceding steps. He should explore the prostate through the artificial opening, and if he should discover a median enlargement, or isolated tumors (lobes), he should dilate the prostatic sinus, or incise it laterally, and enucleate the lateral tumors, and, if there be a median enlargement, excise it," etc.

In 1874 Bottini, of Padua, introduced his operation of division of the median obstruction formed by a middle lobe of an hypertrophied prostate by means of a galvanocautery blade passed through the whole length of the urethra.

In 1836 Parish, of Philadelphia, describes a case in which Dr. Wistar,

of Philadelphia, had made a suprapubic fistula and established permanent drainage of the bladder through a gold tube worn in the fistula. In this case urinary obstruction by an hypertrophied prostate existed.

Sir Henry Thompson, of London, later advocated the same plan.

In 1881 and 1883 Billroth and Leisrink respectively performed total prostatectomy, each in a case of cancer of the prostate. These operations were carried out through the perineal approach.

In 1886 Belfield, of Chicago, performed his first suprapubic prostatectomy. This operation was a partial prostatectomy.

In 1887 McGill, of Leeds, England, reported several prostatectomies in which in some instances one lateral lobe alone, or with the median lobe, were wholly removed by finger enucleation through a suprapubic cystotomy wound. To Belfield and to McGill the suprapubic operation properly should be credited.

In the following year, 1888, Watson, of Boston, published a monograph, which was privately distributed among his colleagues, in which he advocated partial prostatectomy either by the suprapubic or the median perineal route by removal of the median or lateral lobes, when they were the obstructing parts of the gland, and illustrated a galvanocautery instrument devised by him which he had used both through the suprapubic and the perineal median incisions for the purpose of burning through the median obstruction—bar at the neck of the bladder or lateral enlargement of the gland. He discarded the latter method after that year, having done it in the course of his first partial suprapubic prostatectomy in 1889,<sup>26</sup> and also a total perineal median endo-urethral prostatectomy. The last-named case was not published until some years later.

In 1889 Zuckerkandl<sup>31</sup> described his total perineal prostatectomy through a perineal transverse crescentic incision and separation of the rectum from the prostate and finger enucleation through an incision in the posterior surface of the fibrous sheath of the gland.

In 1890 Goodfellow, of San Francisco, performed his first total prostatectomy through the median perineal external urethrotomy incision and endo-urethral finger enucleation. His first report of his method of doing this operation was made before the California Academy of Medicine in April, 1902. He read other communications upon this operation and reported a remarkably successful series of cases in which he had done the operation on 78 patients, with an operative mortality of but 2.5 per cent.

In 1892 Pyle<sup>49</sup> describes the operation of Zuckerkandl and advocates its employment.

In 1894 Nicoll<sup>17</sup> describes the removal of the entire gland by finger enucleation through a perineal incision in combination with the employment of the suprapubic cystotomy incision for the purpose of exercising downward pressure on the prostate to bring it near the perineal surface.

Alexander<sup>1</sup> advocated the combined high and low operation and

removal of the gland through the lower route after freeing it from its attachments by finger enucleation through the sides of the prostatic urethra. Subsequently he abandoned the upper incision and employed the median perineal avenue of approach only.

Fuller, of New York,<sup>7</sup> described fully the suprapubic total prostatectomy. Also in his treatise, *Diseases of the Genito-urinary Organs*, 1900.

The operation described by Fuller, in 1900, Freyer, of London, without the slightest justification, endeavored to appropriate as being original with him in the following year, 1901.<sup>6</sup> His claims to priority have been too completely disproved to call for further notice.

Thus stood the history of the development of the operative treatment of the hypertrophied prostate in the year 1900.

One of the interesting features connected with it is the fact that despite the able and vigorous advocacy of the above-named radical procedures by a number of distinguished surgeons, before the year 1900 the profession turned a deaf ear to their counsel and would have none of it. In some instances, indeed, they withdrew their patients from the care of certain of the advocates of such rash measures. Sir Henry Thompson and Guyon, the two highest authorities upon all matters relating to genito-urinary surgery, pronounced against attempts to relieve patients with prostatic hypertrophy by removal of the gland, and it seemed as though the radical surgical treatment might be doomed to failure.

There was another reason for this delay in the establishment of the operation of total prostatectomy. This was the proposal of J. William White, of Philadelphia.<sup>30</sup> Dr. White reported at the meeting of the association cited above the results of experiments which were conducted in order to study the effects of castration upon the prostate in dogs, and advocated partly upon the basis of the resulting atrophy of the prostate in these animals as a sequence of castration, his proposal to treat hypertrophy of the prostate in the human being by castration.

In the same year Mears, of Philadelphia, proposed ligature and resection of the vasa deferentia for the same purpose.

These two operations were presently practised on a large scale here and in England. The introduction of this method drew the attention of the profession for a number of years from the more radical methods of direct attack upon the prostate itself, and hence delayed total prostatectomy for a good while. The castration and vas resection operations were after awhile abandoned because of having been found far less certain and reliable in their results than total prostatectomy, and because they were shown by Drs. Arthur Cabot and Wood to have a surprisingly high mortality and to be followed in a certain proportion of cases by mental disturbances of more or less severity.

It was not until the period between the years 1900 and 1904 that the operations of suprapubic and perineal total prostatectomy became fully established, after a more or less persistent but unavailing effort

to bring them into use had been made, as recounted above, by a number of surgeons.

The final establishment of the low and the high total prostatectomy operations came through the advocacy of the perineal operation by two brilliant surgeons in France, Albarran and Proust, and later by the able and skilful advocacy of Young, of Baltimore, in America, and in England by the advocacy of Freyer (1901) and others of the suprapubic method.

### SURGERY OF THE URETHRA.

*Fessenden N. Otis*,<sup>18</sup> of New York.—One of the most notable contributions made by American surgeons to genito-urinary surgery is that of Dr. Otis, of New York.

Before the investigations of Otis with regard to the normal caliber of the male urethra there was no standard by which its size could be estimated. Various assertions were made with regard to its normal caliber, but always there was a difference between them. One estimated it by the size of the meatus, another gave without any reason this or that number of millimeters for its normal caliber. There was no accord in the various estimates, nor any data by which to determine what the normal caliber actually was.

In the journal cited above and in other publications subsequently, of which the most important is his work entitled *Practical Clinical Lessons on Syphilis and Genito-urinary Diseases*, published in 1883, Dr. Otis gives his views concerning the normal caliber of the male urethra, the relation of stricture of wide caliber, as he termed narrowings of slight extent, to gleet, and the treatment of stricture of the urethra. With regard to the latter, he believed strongly in the operation of internal urethrotomy properly performed, and devised a new instrument for its performance which is superior to other forms of urethrotomes in all cases of strictures of a caliber not less than 16 of Charriere scale of measurement (Fig. 18). For those of lesser caliber he advised the employment of the instrument of Maisonneuve. He also designed an instrument for estimating the size of strictures. It resembles that which was introduced by the French surgeon Leroy d'Etiolles.

Otis laid down the following rules with regard to the caliber of the urethra and the treatment of stricture by the cutting operation:

1. That the meatus cannot be taken as a guide to the size of the urethra behind it.
2. That the normal caliber of the male urethra is much larger than was previously believed.
3. That the caliber of the average urethra is 32 mm. of the Charriere scale of measurement.
4. That there is a correspondence between the circumference of the flaccid penis and the caliber of the urethra in each person and that both these measurements differ considerably in different individuals.
5. That there are but very few urethræ that are of a caliber less

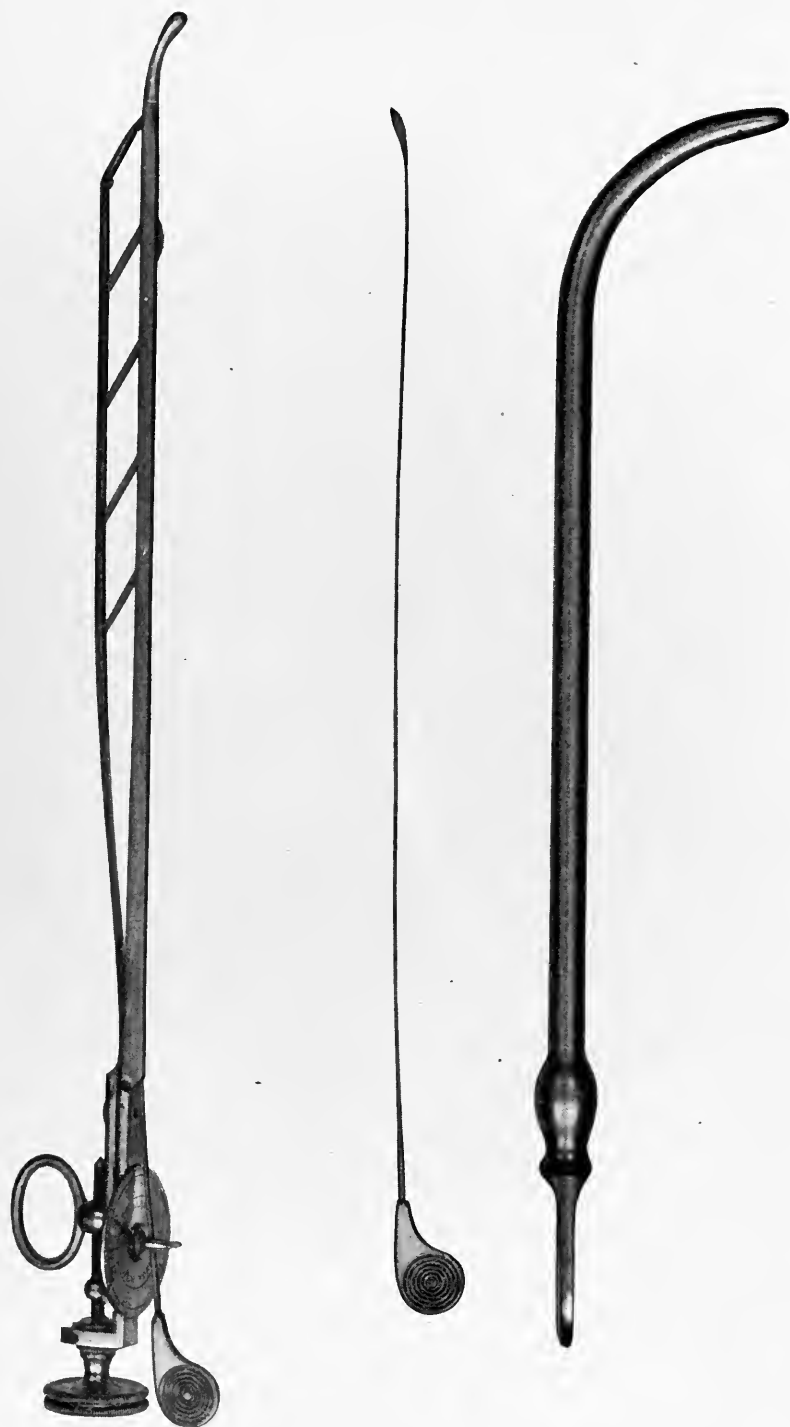


FIG. 18.—Otis's urethrotome and steel sound. (Watson and Cunningham.)

than 28 of the Charriere scale. That there are a considerable number of a calibers larger than 32 of that scale. That there are some that are as large as 40 of that scale.

6. That the caliber of the urethra of a penis which has a circumference of  $3\frac{1}{4}$  inches is 32 mm., and that for every quarter of an inch of increase in the circumference of the penis there is a corresponding increase in the caliber of the urethra of 2 mm. Thus in the penis measuring  $3\frac{1}{2}$  inches in circumference the caliber of the urethra would be 34 mm., and so on. So, too, if the penis measures less than  $3\frac{1}{4}$  inches in circumference, there is a correspondingly smaller caliber of the urethra of 2 mm. for each quarter of an inch in the circumference of the penis.

7. That it is essential to completely divide strictures if one is to secure a permanent result by the operation of internal urethrotomy. That if the division is made in correspondence with the caliber of the urethra in each case, this caliber being established by carefully taken measurements beforehand, and if the incision made by the operation with a dilating urethrotome, such as that of Otis, in such a way as to ensure the restoration of the strictured parts of the canal to the normal caliber of the special urethra in which it is made, and furthermore, if the incisions thus made are kept open subsequently by the passage of a sound of the caliber of the normal urethra every second day after the operation until no blood appears after the withdrawal of the sound, that a large percentage of the patients will be permanently cured.

The view of Otis concerning strictures of wide caliber were shown by Keyes, Weir and others, of New York, to be erroneous. It was demonstrated that the narrowings, to which Otis gave this name, were in most instances anatomical folds of the inner lining of the canal and that they existed in every urethra.

Apart from the last-named factor the views of Otis have been shown to be in the main correct and their establishment produced a decided and very beneficial effect in the treatment of stricture of the urethra. His discoveries also opened the way, as has already been said, to Bigelow to construct his instruments for the performance of the operation of litholapaxy.

*Arthur T. Cabot.*—Cabot was among the earlier American surgeons to urge the employment of the operation of resection of dense strictures of the urethra in the region of the perineum, and reported some cases in which he had practised this operation with successful results.

**Opposition to the Treatment of Stricture by Electrolysis.**—*Edward L. Keyes.*—Keyes rendered valuable service by his opposition to the method of treating stricture by electrolysis, advocated by Newman, of New York.

**Operations upon Varicocele.**—*Edward L. Keyes.*—*Subcutaneous Ligature in Cases of Varicocele.*—Keyes modified the operation of subcutaneous ligature of the veins of varicocele by a clever device which is described in his second edition of the original Van Buren and Keyes, which was published in 1888 (p. 453).

**SURGICAL INSTRUMENTS AND DEVICES INTRODUCED BY  
AMERICAN SURGEONS.**

*W. H. S. Gouley.*—*The Tunnelled Sound to Secure Immediate Dilatation of Stricture* (Fig. 19).—Gouley devised and describes

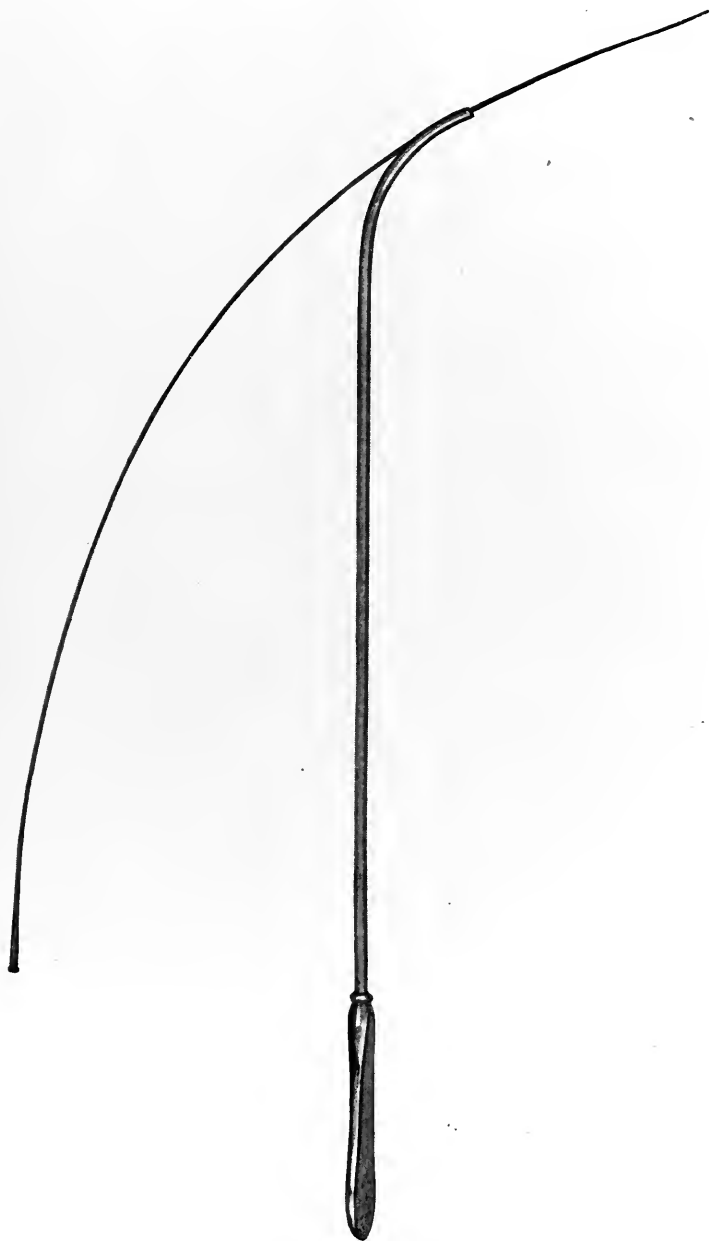


FIG. 19.—Gouley's tunnelled sound with filiform guide. (Watson and Cunningham.)

this instrument in his work, *Diseases of the Urinary Organs*, 1873.<sup>8</sup> It is a tunnelled sound which may be threaded onto a filiform bougie, and using the latter as a guide, can be passed safely through a tight

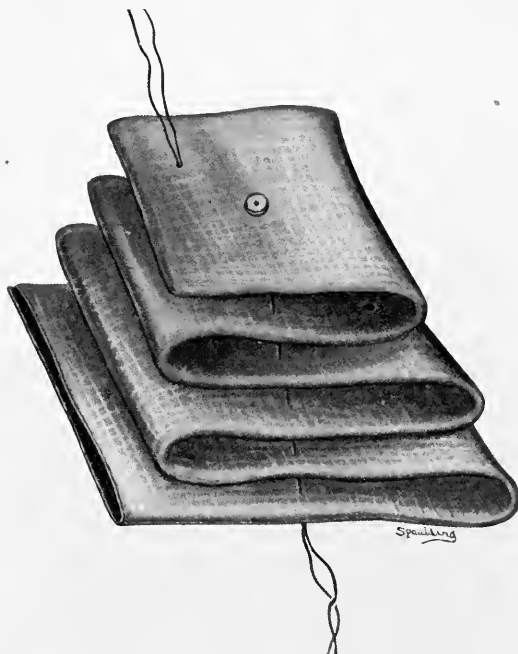


FIG. 20.—Cabot's tampon. (Watson and Cunningham.)

stricture and thus secure a considerable degree of dilatation of the stricture in any case in which it is so narrow as only to allow the passage of the filiform.

*The Keyes-Cabot Tampon.*—To Arrest Hemorrhage after Suprapubic Prostatectomy (Fig. 20).

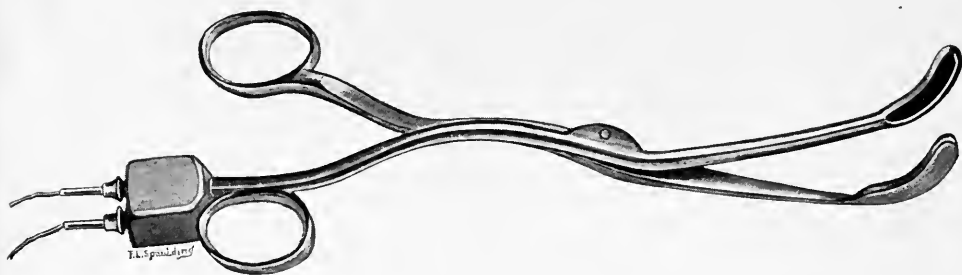


FIG. 21.—Watson's scissors cautery. (Watson and Cunningham.)

Watson introduced several surgical devices which are as follows:

A curette to fit the finger for the purpose of curetting vesical tumors through a perineal boutonnière incision.<sup>24</sup>

A hard-rubber drainage tube to be temporarily worn through a perineal boutonnière and which permits tamponing to arrest hemorrhage after perineal prostatectomy.<sup>29</sup>

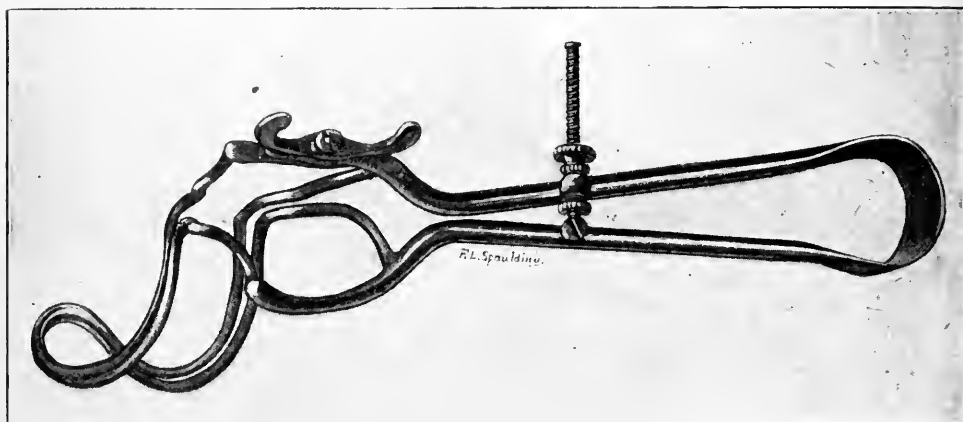


FIG. 22

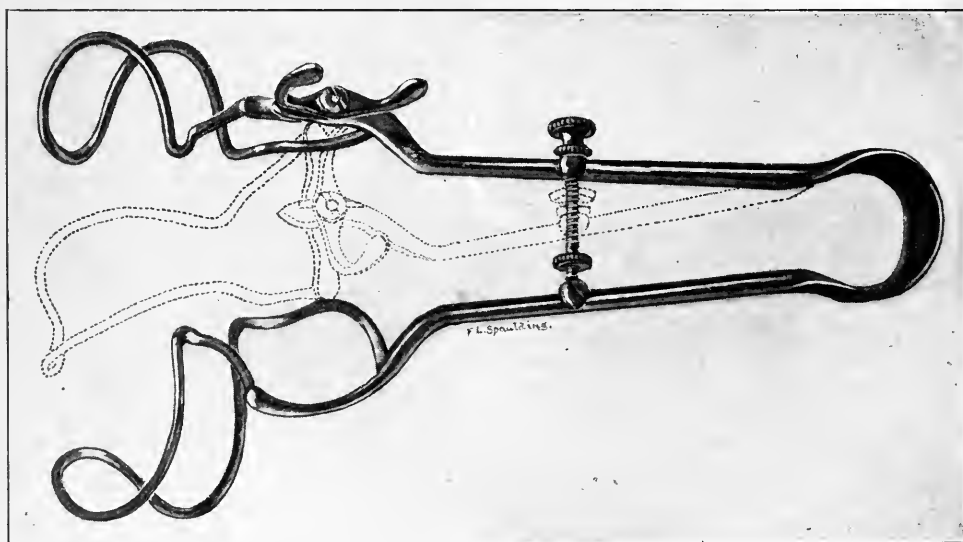


FIG. 23

FIGS. 22 and 23.—Watson's bladder speculum closed and open. (Watson and Cunningham.)

A scissors cautery to remove vesical tumors through a suprapubic cystotomy incision.<sup>27</sup>

A bladder speculum.<sup>28</sup>

A galvanocautery prostatectatome to be applied either through a perineal boutonnière or suprapubic incision.<sup>29</sup>

Apparatus for receiving urine from permanent renal fistulæ in the loins; already mentioned earlier in the chapter (Figs. 21, 22 and 23).  
*Tilden Browne's Modification of the Cystoscope.*

### VENEREAL DISEASES.

The most important single contribution to the treatment of syphilis contributed by an American surgeon is that of Dr. Edward L. Keyes, of New York.

To the effective advocacy of Dr. Keyes the profession in America owes more than to anyone else the plan of employing mercury in small tonic doses during long periods instead of the method of treatment by large doses of the drug which formerly prevailed and to which practice much of the opposition to its use was due. Dr. Keyes was a persistent advocate of the tonic dose mercurial treatment of syphilis, and established its value in the face of strong opposition.<sup>22</sup>

*Robert Taylor, of New York.—Genito-urinary and Venereal Diseases.*<sup>21</sup>—In this excellent volume Dr. Taylor includes the surgical diseases of stricture and of the prostate and other organs of the genito-urinary system, but 470 out of 732 pages of which the volume is composed are devoted to venereal diseases, or nearly two-thirds of the whole volume. The work is far more a treatise on venereal disease than on the surgical maladies of the genito-urinary system, and has usually been so regarded.

### BIBLIOGRAPHY.

1. Alexander: New York Med. Jour., 1896, lxiii, 171.
2. Ashhurst: Phila. Med. Times, April 15, 1872.
3. Bigelow: Am. Jour. Med. Sc., 1878.
4. Covillard: Obs. Iatro-chir., p. 93.
5. Ferguson: Lancet, January 1, 1870.
6. Freyer: Brit. Med. Jour., 1901, ii, 125.
7. Fuller: Jour. Cut. and Genito-Urin. Dis., 1895, ii, 239; also treatise, Dis. of Genito-Urin. Organs, 1900.
8. Gouley: Dis. of the Urin. Organs, New York, 1873.
9. Gouley: Dis. of the Urin. Organs, 1873.
10. Gross: On the Urinary Organs.
11. Guthrie: Anat. and Dis. of the Neck of the Bladder, 1830.
12. Harrington: Ann. of Surg., October, 1893.
13. Ingalls: Boston Med. and Surg. Jour., March 25, 1882.
14. Jackson: Boston Med. and Surg. Jour., August 25, 1870.
15. Keyes: New York Med. Jour., June 16, 1894.
16. Mercier: Recherches sur les Maladies des Organes Urinaires, Paris, 1856.
17. Nicoll: Lancet, April 14, 1894.
18. Otis, Fessenden N.: Calibration of the Male Urethra and its Influence on the Treatment of Stricture, New York Med. Jour., 1872, xv, 152.
19. Pyle: New York Med. Rec., 1892, xlii.
20. Stein: A Study of Tumors of the Bladder, 1881.
21. Taylor: Genito-Urin. and Ven. Dis., 1904, 3d ed.
22. Van Buren and Keyes: Genito-Urin. Dis. and Syph., 1877.
23. Watson: Ann. of Surg., December, 1905.
24. Watson: Boston Med. and Surg. Jour., October 30, 1884.
25. Watson: Boston Med. and Surg. Jour., October, 1884, p. 414.
26. Watson: Boston Med. and Surg. Jour., March 7, 1889.
27. Watson: Lancet, October, 1890, p. 808.
28. Watson: Lancet, October, 1890, p. 809.
29. Watson: The Oper. Treat. of Hypertro. of Pros., 1888.
30. White: Trans. Am. Surg. Assn., 1893, xl, 167.
31. Zuckerkandl: Wiener med. Presse, 1889, xxx, 857-902.

## CHAPTER II.

### THE CYSTOSCOPE AND ITS USE.

By LEO BUERGER, M.A., M.D.

THE interior of the bladder can be brought into view either with the cystoscope or with the endoscope. A cystoscope is a tube carrying a system of lenses (telescope) by virtue of which a field much larger than the lumen of the tube can be seen. An endoscope is a simple metal tube through which light can be thrown to allow of inspection by direct vision.

Cystoscopes may be classified, according to the lens system employed, into two types: the *direct*, in which the plane of the field or view is perpendicular to the axis of the telescope or cystoscope, and the *indirect* or *prismatic*, in which the field is deflected 90°.

**The Direct Cystoscope.**—Through the work of Nitze, an optical system was developed, by means of which a comparatively large portion of the vesical interior can be visualized through a very small tube, the field of view being many times greater than that obtainable with the endoscope. Fig. 24 illustrates the actual field of vision ( $xy$ ) through an endoscopic tube, and that ( $ab$ ) of a Nitze telescope, and shows how they are projected by the eye to  $XY$  and  $AB$  respectively.

**Properties of the Nitze (Direct) Optical System.**—Enclosed in a narrow tube there are three essential lenses: an objective lens or lenses, a middle or inverting lens, and an ocular or eye-piece (Fig. 25). The chief physical properties of such a system are (1) amplification of the field of vision, the picture being in correct or upright position, and (2) magnification of objects as they approach the telescope, the focus being practically correct at all distances (universal focus).

1. *Amplification of the Field.*—The objective is a lens of very short focal distance, which produces a minute, real and inverted image of a comparatively large field (Fig. 25,  $ab$ ) at the distal end of the tube (Fig. 25,  $aB$ ). This image, which is too small to be seen by the naked eye, is transplanted by the middle lens to the eye or ocular end of the telescope, where it can be enlarged by the ocular lens. The eye sees an enlarged, virtual image, whose apparent size depends upon the diameter of the telescope and the magnifying power of the ocular (Fig. 25,  $AB$ ). In short, a field much larger than the capacity of the tube is brought into view.

The illuminated disk that is seen when the objective of the telescope is held toward the sky may be called the "inner field," or apparent or virtual image. The size of the true "outer field," or object, varies with the distance of the objective lens from the plane upon which the tele-

scope looks. The virtual capacity of such a system can be represented by a cone whose base is at infinity and whose apex is at the centre of the objective lens (Fig. 25,  $a c b$ ).

2. *Magnification.*—If such a telescope be held toward the sky and a small object be interposed, the following facts will be noticed: (1) that the illuminated disk or inner field remains the same; (2) that the size of the interposed object varies, becoming larger as it approaches the

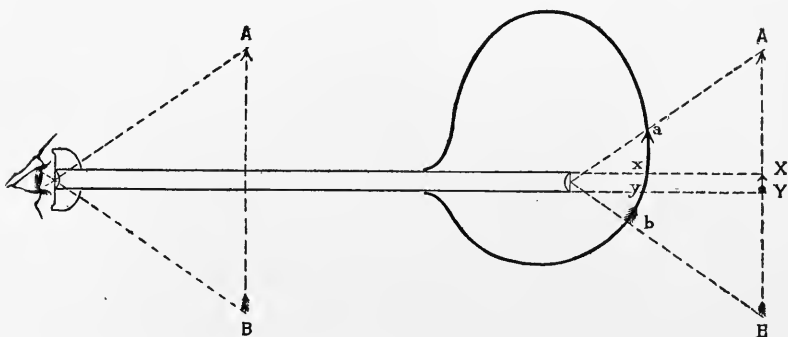


FIG. 24.—Comparison of actual field inspected with a simple endoscopic tube ( $xy = XY$ ) and with a direct telescope ( $ab = AB$ ).

objective, and smaller as it recedes; (3) that when the object is made to approach closely but a small portion of it can be seen, and, conversely, at greater distances more and more of it comes into view.

Fig. 26 will illustrate: Let  $O$  be a telescope, the objective lens of which produces an inverted image ( $\alpha \beta$ ) of the field,  $ab$  ( $aa, bb$  in full-face view) and  $a c b$  the visual angle of the system. Given an ocular of such power that the size of the object ( $ab$ ) and of the enlarged image or

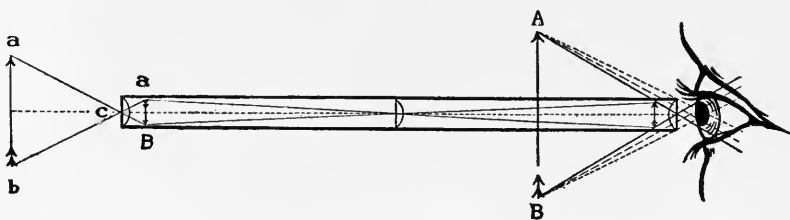


FIG. 25.—Direct telescopic system.  $ab$ , outer field;  $AB$  inner field; angle  $a c b$  = visual angle  $aB$  = small inverted image produced by the objective lens.

virtual image ( $AB$ ) will be identical. In other words, let  $ab$  be situated at a point ( $I$ ) where it appears as large as it really is ( $ab = AB$ ). At  $II$  only a portion ( $a' b'$ ) will be seen. This, however, takes up the same space in the tube ( $\alpha \beta$ ), and therefore will also be seen as large as  $AB$ ; therefore  $a' b'$  is equal to  $A' B'$ . At  $III$ ,  $a'' b'' = A'' B''$ ; at  $IV$ ,  $a''' b''' = A''' B'''$ . The virtual image ( $AB$ ), or "inner field," seen through the telescope always remains the same, but the size of the

outer or actual field rapidly diminishes as it approaches the lens. A small field at a short distance is made to occupy the same amount of space in the virtual (inner) field as a large one, and is therefore enlarged.

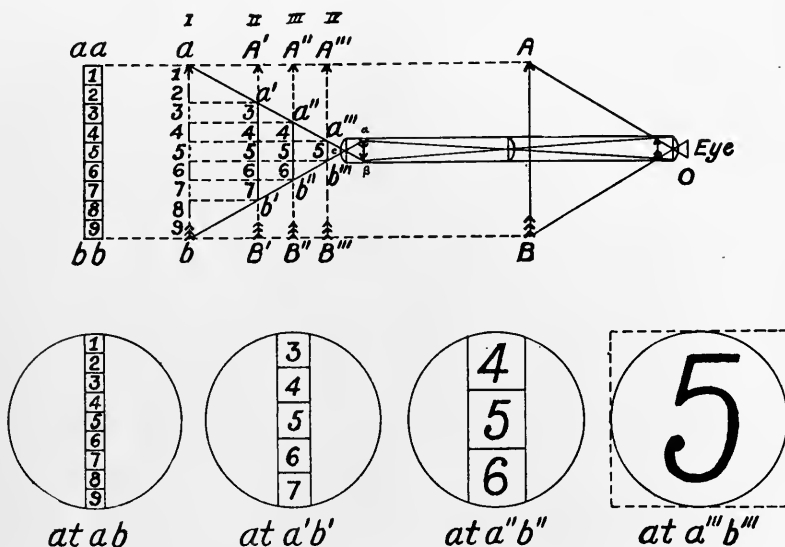


FIG. 26.—Diagrammatic explanation of the magnifying power of the telescope.

This system (the direct, non-prismatic) is employed in all direct telescopic cystoscopes, such as the modifications of Brenner, Brown, Lewis, and in *Buerger's* universal urethroscope.

**The Prismatic (Indirect) Optical System.**—In order to bring the trigone of the bladder more readily into view a right-angled prism is placed in front of the objective. The prism's silvered hypotenuse acts like a mirror, deflecting the whole field 90°, and inverting the

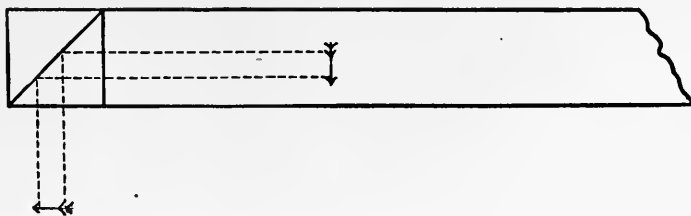


FIG. 27.—The effect of the right-angled prism in inverting the far (north) and near (south) points of the field.

upper (north) and lower (south) parts of the picture, no change taking place as far as left and right are concerned (Figs. 27 and 28).

This optical system was first used in the *Nitze cystoscope* (Figs. 28 and 29). Resembling a metallic catheter, this consists of a shaft, a beak,

and an ocular portion. The shaft contains the optical system.\* At the point *A* there is a window through which the rays from the object or field enter. The beak carries a detachable electric lamp for illumination of the bladder. Near the ocular is the apparatus for attaching the electric coupling *B*. The current is transmitted through the shaft to the beak by way of an enclosed wire, the circuit being completed by the metal wall of the instrument itself. This instrument is known as the Nitze examining or observation cystoscope (Fig. 29).

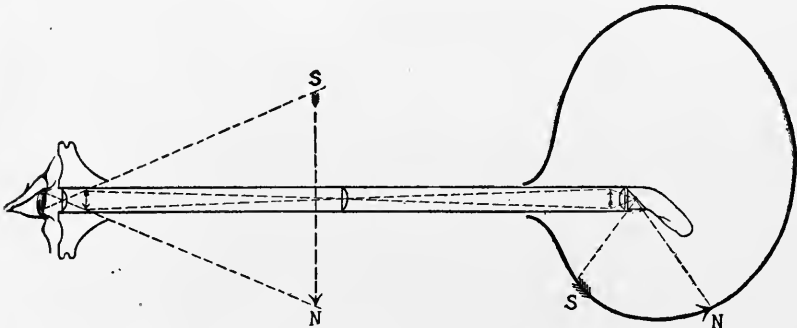


FIG. 28.—Nitze cystoscope in longitudinal section viewing the arrow in the floor of the bladder, the picture seen by the eye being inverted.

**Correct Vision Systems.**—To overcome the disturbing effects of the inversion of the picture E. R. Frank<sup>7</sup> added a second or rectifying prism to the ocular. The most improved methods are those of Ringleb (used in some Continental instruments) and Buerger. In most of the American cystoscopes the system described by Buerger<sup>5</sup> has been

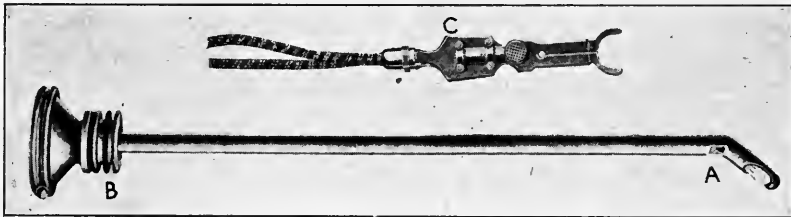


FIG. 29.—Nitze cystoscope, showing sheath with lamp, prism (*A*), contact (*B*), and fork coupling (*C*) for electric connection.

adopted. A modified Wappler prism (a hemispherical lens with one plain side) is the objective, and six middle achromatic lenses and an ocular make up the rest of the system. The objective lens brings about one reversal of the picture, the middle lenses two additional reversals. In the sense of north and south (Fig. 30) the prism causes another inversion, so that we have a total of four reversals for the north and

\* Note that two lenses are employed in the objective instead of one as in our diagrams. The second lens tends to overcome spherical aberration.

south points and three reversals for the east and west points (Fig. 31). This naturally results in the production of an image whose north and south poles are upright and correct, and whose east and west points are reversed. The interchange of these points is then brought about by a

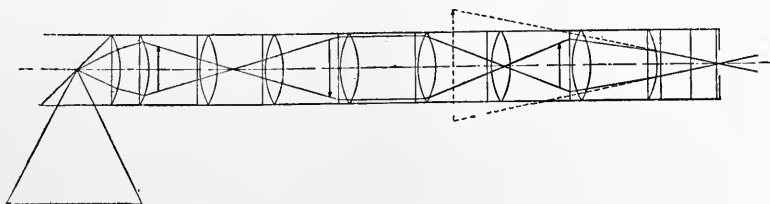


FIG. 30.—The course of the rays from north and south points through the corrected lens system, showing four reversals of the arrow, the result being an upright picture.

simple reversing prism of  $90^\circ$  (Fig. 31) that is placed in front of the ocular. This system gives a larger field of vision and a great deal more light than is obtainable in any other telescopic system.

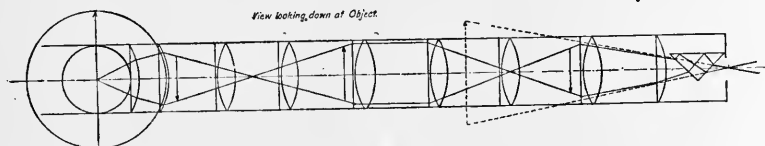


FIG. 31.—The course of the rays in the same telescope from east and west, showing three reversals through lenses, one reversal by the prism, the final result being non-inversion.

Since a corrected or upright picture greatly facilitates cystoscopic work, the above optical system has been almost universally adopted in the United States. In all future descriptions, therefore, the use of this system will be understood.

### CYSTOSCOPES.

In addition to the classification into *direct* or *indirect* varieties, cystoscopes may be grouped as *examining* (observation) and *catheterizing* instruments, according to their special function.

**Direct Cystoscopes.**—This type had been used by Nitze for purposes of examination before he had improved the cystoscope through the addition of a prism. Brenner, by adding a catheter channel, was the first to employ this instrument for catheterization of the ureters. F. Tilden Brown improved this by separating the telescope from the sheath, the former carrying channels for two catheters for synchronous ureteral catheterization (Fig. 32). Later, Brown modified this instrument by cutting an additional fenestra into the concave aspect of the beak and by rearranging the lamp. This permitted of the introduction and the application of a telescope of the indirect type for ureteral

catheterization. To this instrument he applied the name composite cystoscope. Bransford Lewis developed a similar instrument, calling it universal cystoscope.

The field of vision of the cystoscope illustrated in Figs. 23, 24 and 25 will be seen to encompass a cone whose apex is at the objective and whose base lies in planes perpendicular to the axis of the telescope. When introduced into the bladder such a cystoscope would look directly

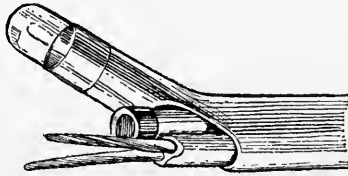


FIG. 32.—The beak of the Brown direct catheterizing cystoscope showing lamp, objective end of telescope and two catheters projecting.

at the posterior wall. For a thorough inspection of the bladder it has certain disadvantages which have resulted in its being gradually supplanted by the prismatic type of instrument. Thus, it is necessary to make wide excursions with the instrument to inspect the interior of the bladder. Although this is feasible without much distress to the patient in the female, it is almost impossible to make adequate excursions in the case of the male. Fig. 33 illustrates the wide sweep that

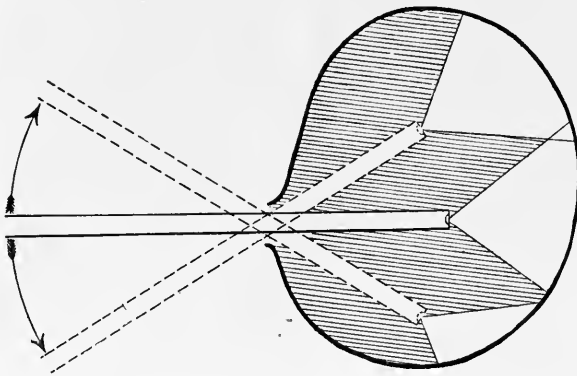


FIG. 33.—Wide excursion of the direct cystoscope in order to bring the posterior wall of the bladder into view with a direct cystoscope.

must be made with the shaft of the instrument in order to bring a considerable portion of the bladder interior into view. The prismatic cystoscope is not open to this objection, since by rotation about its long axis (Fig. 34) an annular band, including roof, lateral walls, and floor of the bladder, can be seen. By an inward or outward movement along its long axis combined with rotation, almost the whole of the bladder interior can be inspected.

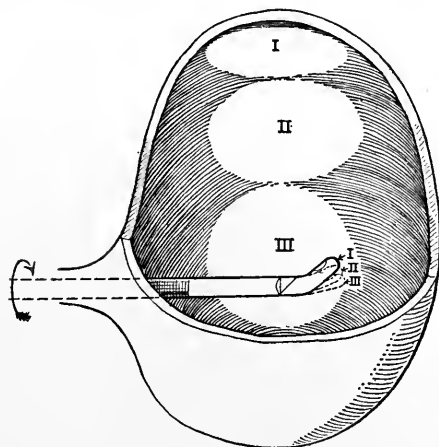


FIG. 34.—Annular band around the whole bladder brought into view by rotation of the prismatic cystoscope on its long axis, very slight rotation bringing the fields *I*, *II*, and *III* into view.

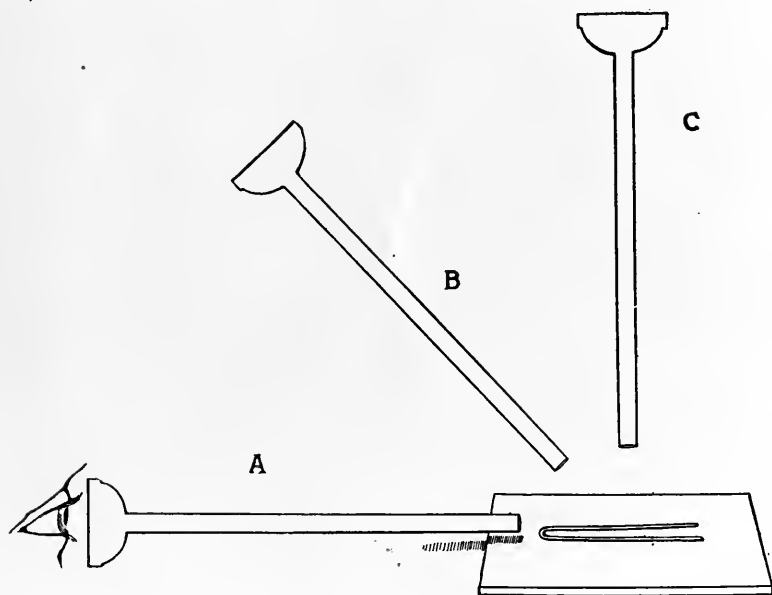


FIG. 35



FIG. 36

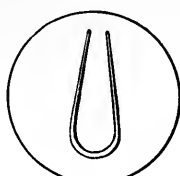


FIG. 37

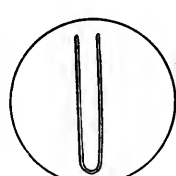


FIG. 38

FIGS. 35, 36, 37 and 38.—Diagrammatic drawings demonstrating that only objects lying in planes perpendicular to the axis of the direct cystoscope suffer no distortion.

Another disadvantage of the direct system is the fact that only objects that lie in planes perpendicular to the long axis of the telescope escape the effects of distortion. Figs. 35, 36, 37 and 38 demonstrate this fact, the hair-pin having a grotesque appearance when telescope and object are parallel. When the most important portion of the bladder is viewed, namely, the trigone and ureteric orifices, the ocular end of the instrument must be raised so as to depress the objective against the floor of the bladder (Fig. 66). Under these circumstances the plane of the trigone is almost parallel to that of the long axis of the instrument. The trigone and ureters, therefore, will come but poorly into view. The prismatic telescope will give a perfect picture of this region.

**The Prismatic or Indirect Cystoscope.**—Here the eye of the observer may be regarded as transferred from the region of the ocular to the objective, where it looks in a direction perpendicular to the shaft of the instrument (Figs. 28 and 50).

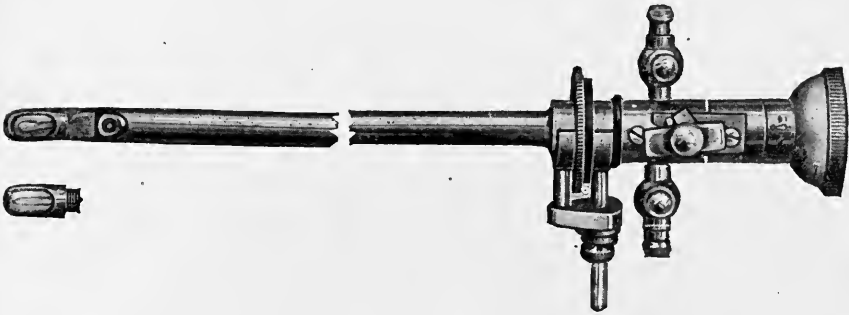


FIG. 39.—Otis-Brown-Nitze cystoscope.

For a long time the prismatic cystoscopes were unpopular in the United States because of the difficulty in interpreting the inverted picture. Since the introduction of the corrected systems<sup>1</sup> the advantages of the prismatic type have become evident to most all cystoscopists, so that the indirect system is most widely used today.

The most generally useful examining cystoscopes are the *Buerger*, *Otis-Nitze*, or *Nitze* (Fig. 39). The first will be described under Catheterizing Cystoscopes.

**Otis-Nitze Cystoscope.**—The Nitze evacuating cystoscope for purposes of observation was improved by Otis and Brown by the use of a Wappler hemispherical lens and a change in the pattern of the beak. The Otis-Nitze consists of a sheath carrying a lamp, a fenestra through which the objective looks, two irrigating faucets at the ocular end, and an observation telescope. After removal of the telescope the sheath can be employed for irrigation of the bladder. Where an examining cystoscope of smaller caliber than the Buerger instrument is desired, this cystoscope will be found serviceable.

**Catheterizing Cystoscopes.**—In order to provide for the collection of urine from each kidney separately, the examining cystoscopes had to

be modified so as to carry catheters that could be inserted into the ureteral orifices under the guidance of the eye.

**Direct Catheterizing Cystoscopes.**—Brenner converted the direct cystoscope into a catheterizing instrument in 1887 by placing a channel for one ureteral catheter below the telescope.

F. Tilden Brown improved the Brenner cystoscope by separating the sheath and the telescope, the latter carrying the catheter bed or channels (Fig. 32). The sheath carries the lamp and provisions for electric contact, and is closed with an obturator before introduction into the bladder.

**Indirect Catheterizing Cystoscopes.**—All instruments of this type are based upon the Nitze instrument, in which it was found necessary to add a mechanism for deflecting the catheters so that they would have the proper direction for insertion into the ureters. Albarran's deflector, or finger, which could be elevated or depressed by a mechanism situated at the ocular end of the instrument, is the most useful device of this kind, and, in somewhat modified form, is still in use today.

**The Nitze-Albarran Cystoscope.**—In America this instrument possesses merely historical interest. It is the Nitze observation instrument with provision for the introduction of one or two ureteral catheters that may be passed through a separate channel in the shaft of the instrument. Because of many mechanical disadvantages this instrument has been discarded almost completely in the United States, and has been supplanted by the *Buerger* cystoscope.

**The Buerger Catheterizing Cystoscope.\***—This instrument (Fig. 40) consists of four parts, the sheath, the obturator, the observation telescope, and the catheterizing telescope. The sheath is circular on cross-section, bears a very short lamp at its end, and possesses a large fenestra or window behind the lamp. Its caliber is about 24 French.† The obturator closes the working aperture perfectly. The observation telescope is large, but does not completely fill the sheath, room being left for irrigation. The catheterizing telescope combines in one piece the optical apparatus, the mechanism for deflection and the catheter grooves or beds. At the objective end the catheters may be fastened by a clip; at the ocular end there are two catheter channels through which the catheters emerge. These are provided with rubber tips or nipples that firmly grasp the catheters and prevent the escape of fluid from the bladder. A large deflector or catheter lift is implanted near the objective.

This instrument presents the following advantages: the employment of a catheter for washing the bladder is unnecessary, the sheath serving this purpose; because of its small size, its round shape, the smoothness in the region of the beak and window, the introduction of this instrument is easy, and injury to the deep urethra is avoided; synchronous ureteral catheterization with two No. 6 French catheters is

\* Sold under the name of Brown-Buerger Cystoscope, because the sheath principle popularized in the United States by Brown was adopted. (This principle had been introduced by Nitze in his "Evacuation Cystoscope.")

† Recently, Buerger has devised a smaller (21 Fr.) double catheterizing cystoscope carrying 2 No. 6 French ureteral catheters. The design is the same as that of the above.

possible, and the telescope and sheath may be removed, leaving the catheters in the ureters; irrigation of the bladder may be very rapidly effected, through the sheath after removal of the telescope, or more slowly through the faucets, even while the process of catheterization is going on; the separation of the catheters in their grooves avoids friction

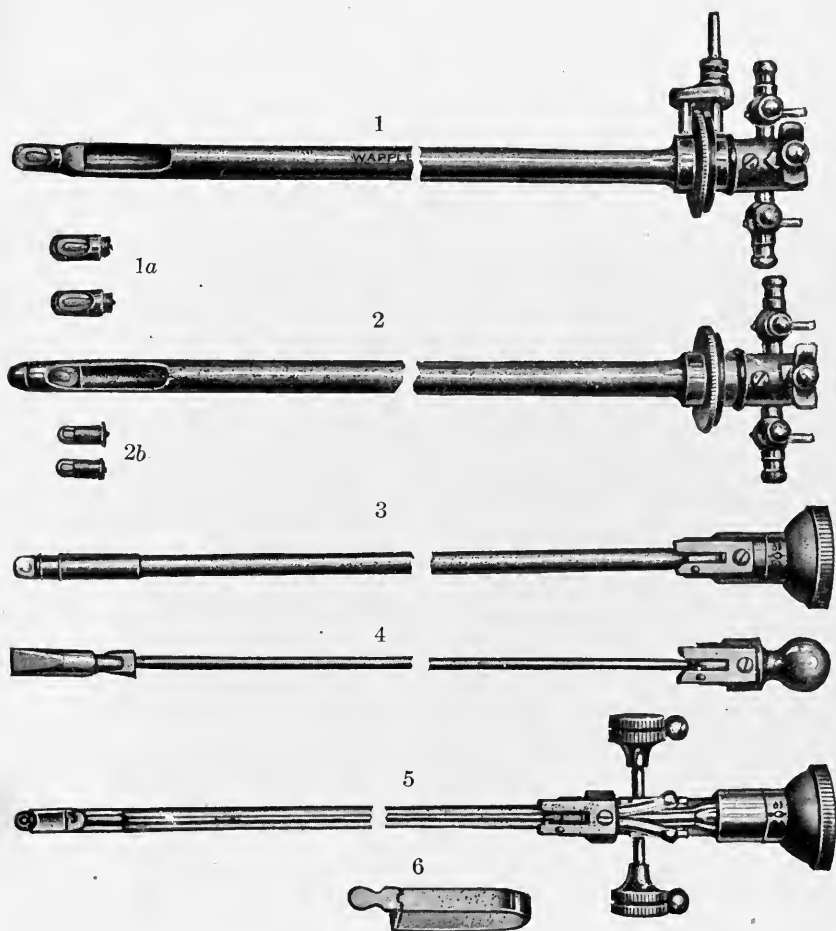


FIG. 40.—Buerger catheterizing cystoscope: \* 1, concave sheath; 2, convex sheath; 2b, extra lamps; 3, observation or examining telescope; 4, obturator; 5, catheterizing telescope; 6, clip to hold catheter against telescope.

between them, and a new catheter can be inserted at any time without removing the telescope; the relation of the lamp to the objective lens gives the best illumination and prevents burning of the bladder wall; inasmuch as the catheter-bearing mechanism is separable from the sheath, and is not introduced until the bladder is cleaned, the likelihood

\* For children, Buerger has constructed a single catheterizing cystoscope of 15 French caliber, and recommends a 12 French observation cystoscope of the Otis-Nitze type for observation cystoscopy.

of carrying infection into the ureters is reduced to the minimum; if the lens becomes soiled, the telescope may be removed without disturbing the sheath, or a larger observation telescope may be substituted.

The typical sheath carries the lamp on the concave side of the instrument (Fig. 40, No. 1) and is called the concave type of sheath, the fenestra and lamp being on the same side. An additional sheath is provided (Fig. 40, No. 2), in which the convex portion of the beak encloses the lamp. This allows of very close approximation of instrument and bladder wall, and is applicable in contracted bladders, where distention of the bladder is impossible, when a very close view is essential, whenever work must be done at close range, and when the sphincter and posterior urethra are to be examined, particularly in prostatic adenoma (hypertrophy).

**Composite or Universal Cystoscope.**—A number of workers have attempted to make the direct and indirect methods of procedure applicable in one sheath. For this purpose the sheath is provided with two fenestræ, one on the concave side of the lamp for the indirect telescope, the other at the convexity for the projection of the objective of the direct telescope. Because of the larger size of the beak, the inadequacy of illumination for indirect vision, the weakness of the mechanism in the region of the beak, and many other mechanical disadvantages such instruments are not recommended. F. Tilden Brown and Bransford Lewis have both devised instruments of this type.

**Endoscopic Tubes.**—These are simple tubes of varying diameters, and are called urethrosopes when employed for inspection of the urethra. They are of two types, male and female. Gruenfeld introduced these in 1881 for use in the urethra, and both Pawlik and Howard Kelly, of Baltimore, demonstrated that, at least in the female, the ureters could be catheterized with comparative ease through a mere tube, into which light could be reflected from a forehead mirror from a lamp situated near the eye portion of the tube or from a small light carrier inserted into the tube itself.

**The Elsner-Braasch Cystoscope.**—This is a modified endoscope consisting of a sheath carrying a beak and lamp, an obturator and a small glass window to close the eye-end of the tube. When used in a water medium, a direct view is obtained without the intervention of any lenses, the observer looking through the window down the water-filled sheath. Ureteral catheters may be passed through special channels, no deflector being necessary, the technic being similar to that employed with the direct cystoscopes. Because of the restricted field of vision the wide excursions necessary to bring the bladder interior into view, and the difficulty of finding the ureters, particularly in pathological bladders, the instrument will scarcely find general adoption. In the hands of a very few experts it may answer in the majority of cases.

**The Kelly Endoscope.**—A simple tube (Fig. 41) provided with an obturator and handle is successfully used by many for ureteral catheterization in the female and also for inspection of the bladder. Light is thrown into the bladder with a forehead mirror. In certain modified

models of this instrument a small lamp is attached either to the eye-end of the tube or carried inward on a small light carrier. The Kelly-Pawlik method is not recommended for observation cystoscopy, since the field obtained is too limited. In the female, however, it has a sphere of usefulness for purposes of ureteral catheterization.



FIG. 41.—Kelly speculum or endoscope.

**The Luys Endoscope.**—Luys employs a simple endoscopic tube for catheterization of the ureters even in the male, and has modified the instrument by the addition of a small magnifying lens in front of the eye-end of the instrument and a small canal through which the urine can be aspirated and the field kept dry.

### CYSTOSCOPIC ACCESSORIES.

**The Lighting Apparatus.**—The source of electricity is preferably the street current, but a dry cell, storage or other battery may be employed. The requisite amount of current is obtainable through a controller\* that can be attached to any universal lamp socket. Current should be turned on gradually until the outlines of the lamp filament become blurred and the light becomes white, the instrument being tested and the proper amount of current determined before its introduction into the bladder. Dry-cell batteries (single or six-cell pocket battery with rheostat) are often serviceable, though larger portable batteries containing two to six cells will last longer and give more satisfaction in an office not equipped with electric light.†

**Sterilization.**—After cleansing with green soap and water, then alcohol, the cystoscope may be sterilized either in pure carbolic acid or in formaldehyde vapor. A carbolic acid sterilizer may be improvised by placing two large tubes or cylindrical vessels in a wooden stand, one containing carbolic acid and the other 95 per cent. alcohol. The cystoscope is plunged into carbolic acid for five minutes, then immersed in alcohol, and finally washed with sterile water.

\* The Wappler controller, No. 3, is one of the best instruments for this purpose.

† Wappler Catalogue, No. 59, p. 19.

A formaldehyde sterilizer\* in which there is provision for the development of formaldehyde is even more reliable. Formaldehyde vapor is developed by allowing a tablet of paraform to be vaporized over a lamp. The instruments should be kept in this vapor for several hours, preferably overnight, and must be rinsed off with sterile water before using.

**Cystoscopic Table.**—A table suitable for cystoscopic work should permit the patient to be comfortably placed in the following positions: lithotomy position, the modified lithotomy position with legs hanging down, Trendelenburg, and knee-chest position.†

**Anesthesia.**—Although an anesthetic may be dispensed with in many cases, it is a good plan to employ novocain or alypin as a routine in males, and occasionally even in the female. A 2 and 4 per cent. solution of novocain and a  $1\frac{1}{8}$ -grain tablet of alypin or novocain should be at hand. Lubrichondrin or K Y,‡ to which 4 per cent. novocain or alypin has been added (Barringer), is a good preparation.

The following is a useful method of obtaining local anesthesia: After cleansing of the foreskin and meatus, the patient voids, and the urethra is irrigated with a 2 per cent. boric acid solution. The anterior urethra is then distended with a 2 to 4 per cent. novocain solution and closed with a penis clamp. After five minutes have elapsed, about 15 c.c. of the novocain solution are injected into the urethra in such a manner that the greater part of this solution enters the bladder, the urethra remaining distended for an additional five minutes. Some recommend the introduction of a tablet of alypin or novocain ( $1\frac{1}{8}$  gr.) into the posterior urethra by means of a special tablet depositor (Bransford Lewis), or the injection of a 4 per cent. alypin-lubrichondrin into the urethra for five minutes, the instrument being then anointed with the same preparation.

Suppositories containing 1 grain of codein or  $\frac{1}{4}$  grain of the extract of belladonna with  $\frac{1}{2}$  grain of the extract of opium may be administered an hour before the examination in irritable patients. In rare instances nitrous oxide gas anesthesia or epidural injection of 10 c.c. of a 0.5 per cent. novocain solution will be necessary.

**Solutions.**—Since cystoscopy with telescopic instruments necessitates the distention of the bladder with a clear fluid, a warm 2 per cent. boric acid solution must be at hand. It is best employed in an irrigator, but may also be injected with a 5- to 6-ounce syringe.

Indigo-carmin (0.08) mixed and boiled in 15 to 20 c.c. of sterile normal salt solution may be injected into the buttocks, if selected as a functional test; or phenolsulphonephthalein§ (vial of 1 c.c.) is introduced either into one of the arm veins or under the skin.

**Ureteral Catheters.**—The French silk-woven catheters¶ are the best. They vary in size and in the shape of their tips or collecting ends. They

\* Hospital Supply Company, New York.

† Buerger-Hyman table made by the Hospital Supply Company, was especially designed for this work; or the Buerger combined cystoscopic and radiographic table.

‡ Van Horn & Sawtell, New York.

§ Hynson & Westcott, Baltimore, Maryland. ¶ Eynard make is recommended.

may terminate in an olivary point with one or two lateral openings, in a whistle-shaped tip, with lateral holes, in a single terminal opening without any lateral holes, or with a rounded, closed end with a lateral opening. The most serviceable are the olive-tip and the whistle-tip catheters; the former are preferred for routine work since they more easily surmount obstruction in the ureter; the latter have the advantage of giving a somewhat more copious flow.

Although the No. 6 French catheter is recommended for routine use, it will be necessary occasionally to employ one of 4 or 5 French caliber. In pyelography where reflux of the injected argyrol or collargol must be prevented, or in estimating the total output of a kidney, or in order to collect thick purulent secretions, etc., a larger catheter from 7 to 12 French may be introduced through an operating cystoscope.\*

**Lubricants.**—A lubricant containing tragacanth put up in tubes has given us satisfaction.† Four per cent. novocain or 4 per cent. alypin may be added to aid local anesthesia. Sterile glycerin or liquid petrolatum may also be employed.

**Syringes.**—A complete outfit includes a 1-ounce syringe with rubber tip for injection of novocain solution; a small 5 to 10 c.c. syringe for washing the pelvis of the kidney, injecting fluid, oil, or glycerin into the ureteral catheters and provided with a special conical blunt needle to fit into any ureteral catheter; a 20-c.c. syringe for indigo-carmin injection; a small hypodermic syringe for injection of phenolsulphonephthalein; and a 5-ounce syringe for injecting fluid into the bladder when an irrigator is not at hand.

**Other Accessories.**—Other accessories are rubber tips or nipples, with or without perforation, to occlude the catheter outlets; clips to hold catheters in their beds in the telescope; cystoscope holder, especially valuable in females to grasp the cystoscope and to hold two test-tubes for collecting specimens.

**Preparation for Cystoscopy.**—Although a complete armamentarium for the use of the specialist includes a larger number of instruments, a satisfactory set would include a Buerger observation and catheterizing cystoscope,‡ an Otis-Nitze examining cystoscope,§ a cysto-urethro-scope,¶ an operating cystoscope,\*\* and a Kelly endoscope.††

The cystoscope selected for use, after sterilization, is laid out on a sterile towel and the lamp tested. Preparation of a male patient includes the cleansing of the external parts, the irrigation of the urethra with a 2 per cent. boric solution with a hand syringe followed by the application of the local anesthetic. After ten minutes have elapsed

\* Buerger or Brown or Bransford Lewis instruments.

† So-called "K-Y," Van Horn & Sawtell, New York.

‡ Manufactured by Wappler Electric Mfg. Company, catalogue 59, p. 2, Brown-Buerger combination cystoscope.

§ Wappler Electric Manufacturing Company.

¶ Wappler catalogue 59, pp. 9, 10 and 11 (Buerger cysto-urethroscopes).

\*\* Ibid., pp. 6 and 7, Buerger operating cystoscope.

†† Manufactured by all surgical instrument makers under the name of Kelly speculum or Kelly endoscope.

the patient may be put in the position for cystoscopy. In the case of the female, after irrigation of the vagina and thorough cleansing of the external parts, a tablet of novocain or alypin may be introduced into the urethra with forceps. A slightly modified lithotomy position will be found to answer in most cases, except for the Kelly and Luys methods, which require either the knee-chest posture or an exaggerated Trendelenburg.

**The Introduction of the Instrument.**—In the case of the female this requires no special comment, but in the male the technic is as follows: The operator standing in front of the patient holds the penis in the left hand, puts it on the stretch, everts the lips of the meatus, and is ready to pass the well-lubricated cystoscope through the urethra. The sheath with the obturator in place is allowed to slip into the urethra as far as the bulb, by its own weight whenever possible, until it meets the resistance of the bulbomembranous junction. Here it is allowed to rest for a second or more. The ocular end of the instrument is then depressed until a sensation of penetration begins to make itself manifest. A slight rotation of the beak from one side to the other may facilitate in this maneuver, and a finger of the left hand (which has now released the penis) may aid by pressing the beak of the cystoscope upward against the pubic arch. The instrument will then suddenly plunge through the posterior urethra and into the bladder, while the right hand continuously depresses the ocular end. The obturator is then removed, the urine collected in a sterile vessel, and the bladder is irrigated with a 2 per cent. boric solution from an irrigator until the return flow is perfectly clear. Either the observation or the catheterizing telescope is now inserted, locked in place, and the boric acid allowed to flow into the instrument through one of the lateral faucets until 150 to 200 c.c. have entered.

**Technic of Observation Cystoscopy.**—Four motions of the cystoscope must be mastered: motions of translation, rotation, a pendulum or rocking motion, and a motion of circumduction.

By the motion of translation we mean an inward and outward movement of the instrument (introduction and withdrawal). In Fig. 42 the positions *A*, *B* and *C* bring into view the greater portion of the anterosuperior wall, vertex and posterosuperior region. When associated with rotation around the long axis of the shaft, the lateral walls and floor also are visualized (Fig. 34). A motion of translation alone, when the beak is turned down, gives a survey of a band of the floor of the bladder, whose width depends upon the distance of the objective lens from the floor, it being remembered that the nearer the objective, the smaller the field. Complete rotation affords a view of an annular band extending around the whole bladder. Therefore the two motions of rotation and translation demonstrate practically the whole of the bladder except a small area of the posterior wall and the immediate neighborhood of the sphincter.

The combined motions of introduction, withdrawal, and rotation do not suffice, since the illumination is scarcely adequate at all distances,

and since details will not be sufficiently magnified until the objective is brought nearer to the bladder wall.

Therefore the rocking or pendulum motion is useful. By this we mean the elevation and depression or side-to-side movement of the ocular with consequent conjugate motions of the beak. These are appropriate to exhibit the posterior wall (Fig. 43), and the juxta-

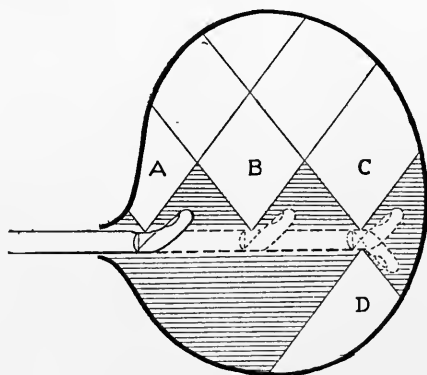


FIG. 42.—Inspection of (A) anterosuperior, (C) posterosuperior, and (B) vertex, by motion of translation; in a similar manner the floor of the bladder (D) is brought into view.

sphincteric portions of the anterior wall; for the purpose of magnifying objects, and for special conditions, as in cystocele, diverticula, adenoma of the prostate, etc.

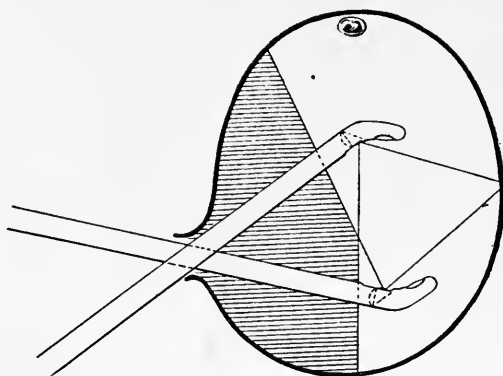


FIG. 43.—Rocking or pendulum motion to demonstrate the posterior wall.

Motions of circumduction combine the rocking motion with rotation and offer the possibility of a more comprehensive view of larger objects, such as stones or tumors.

**The Routine of Inspection.**—The following is a useful scheme:

*First:* Obtain a superficial view of the superior wall with the beak turned up, introducing and withdrawing until the air-bubble comes into

view (Fig. 44). The air-bubble occupies the highest point of the bladder, being air introduced into the bladder upon insertion of the sheath. Do not tarry in this examination, since the inspection of the floor of the bladder is most important and should be executed first.

*Second:* Examine the floor (including trigone and ureteric orifices) after having rotated the instrument so that the beak looks down. (Fig. 42, D.)

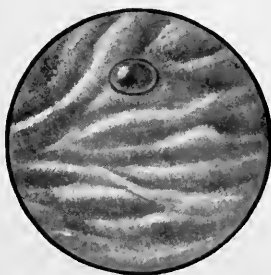


FIG. 44.—Air-bubble seen with the beak turned upward when vertex is inspected.

*Third:* Finding of the ureters. Carry the cystoscope well into the bladder (Fig. 45) and the field becomes dark, for the lamp has impinged against the posterior bladder wall, leaving the greater part of the field dark (Fig. 46); withdraw slightly and the retrotrigonal region appears. If the illumination is imperfect, you are probably too far away from the

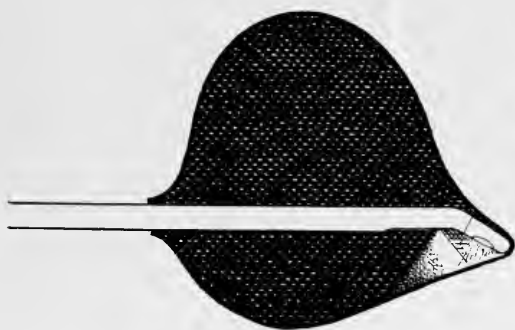


FIG. 45.—Finding of the ureters; first position.

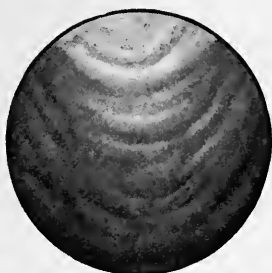


FIG. 46.—View obtained with the cystoscope as seen in Fig. 45. Upper part of field illuminated, lower portion dark. If cystoscope is pushed still farther in, the whole field may become dark.

floor, and the ocular must be raised. Continue the recessive motion (withdrawal) until the interureteric bar or ridge, a fold running transversely between the ureters, comes into view (Figs. 47 and 48). This is distinguished by its marked vascularity, darker color, and prominence in the male, although in the female the markings may be less distinctive. Even here, however, the change in the color of the mucous membrane, fascicles of prominent vessels, running sagittally, will indicate

its presence. Allow the bar to occupy the centre of the field and rotate about 20 degrees to either side and the ureters will come into view

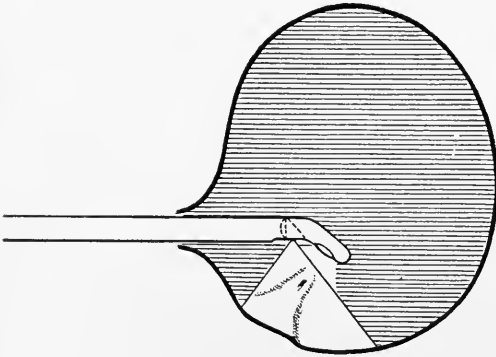


FIG. 47.—Finding of ureters. Second position. The interureteric bar occupies the middle of the field.

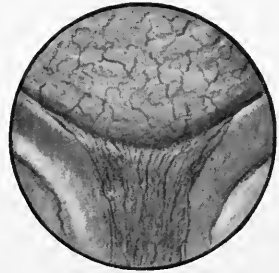


FIG. 48.—View obtained with the cystoscope as in Fig. 47; the interureteric bar runs across the field; above, the retrotrigonal region; below, the more vascular area of the trigone. The ureteral orifices lie outside of the field.

(Fig. 49). Examine the ureters carefully, both with the instrument in the position of lateral rotation and also with the shaft carried into the line of the course of the ureter, a position which is obtained by bringing the beak toward the opposite side of the patient. By raising the ocular the details of the ureteric orifices will be brought distinctly into the field. Note the intermittent vermicular contractions of the ureteral orifices and the character of the efflux or urinary jet.

*Fourth:* Study the trigone itself.

*Fifth:* Proceed to the inspection of the superior wall by turning the beak upward.

*Sixth:* View the lateral walls by combining the motion of translation with rotation, and with the cradle motion so as to bring the beak nearer to the wall.

*Seventh:* Examine the posterior wall with the beak down or up by a rocking motion (Fig. 43).

*Eighth:* Inspect the sphincter by rotation after having drawn the objective into the urethrosphincteric margin, so that the prism lies partly within the urethra, partly within the bladder.

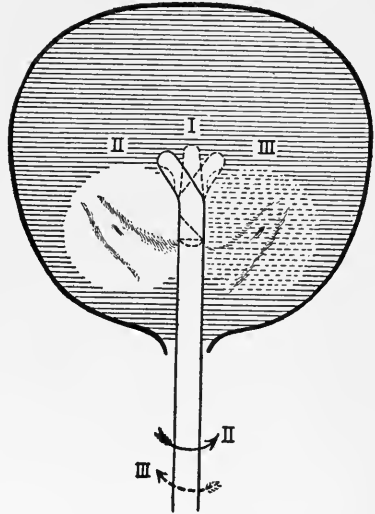


FIG. 49.—Finding the ureters. Third position. I, cystoscope in the midline looking at the interureteric bar; II, cystoscope turned to the patient's right to see the right ureter; III, to the left, to see the left ureter.

*Ninth:* Remove the instrument with the light turned off, the telescope removed, and with the obturator reinserted.

**Elementary Principles of Observation Cystoscopy.**—For a thorough comprehension of the field of view (outer field) of the indirect cystoscope, certain elementary physical principles must be known: (1) we must study the relation of the inner field to the position of the cystoscope; (2) the movements of this field induced by the motions of the instrument; (3) the problem of magnification; (4) the observation of the internal sphincteric region; and (5) the question of illumination.

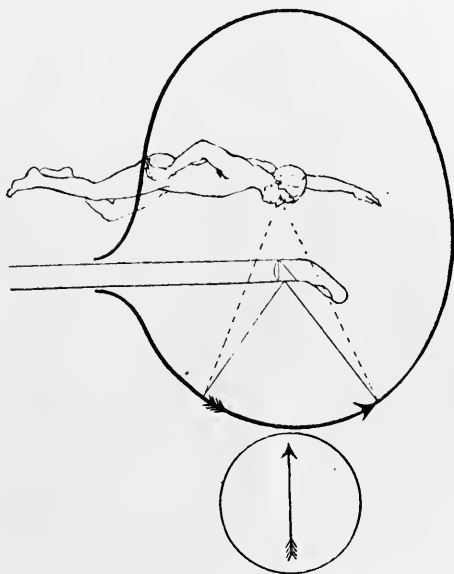


FIG. 50.—Viewing the floor of the bladder, far point (north) occupies the upper portion of the field, near point (tail of the arrow) the lower part of the field.

**Relation of Field and Cystoscope.**—It is necessary to remember that the eye of the observer is transferred to the objective of the cystoscope and looks in a direction perpendicular to the shaft of the instrument. With the objective looking down upon the floor of the bladder the field is that of a swimmer headed in the same direction as the beak. The view obtained by the cystoscope as it is pushed inward is comparable to that of such a swimmer (Fig. 50).

When the anterior and superior walls are inspected the view is that of one swimming on his back and looking upward at the vertex of the bladder (Fig. 51).

When the right wall is examined, the swimmer is treading water and looking to the patient's right, so that a "far"\* point will be on the examiner's right; conversely, for the left wall, the swimmer looks to the left and the far points will be on his left.

\* Far points in the anteroposterior direction are away from the cystoscopist, hence nearer the posterior wall.

**Induced Movements of the Field.**—One of the most disturbing phenomena is the apparent movement of the interior of the bladder consequent upon motion of the cystoscope. The up-and-down motions that attend movements of translation are easily comprehended by keeping the positions of the swimmer in mind. But when the cystoscope is rotated on its long axis, or when a rocking motion is carried out, the changes in the field are somewhat more confusing.

On rotating the cystoscope with the beak down, toward the patient's right (clockwise), the field will seem to travel in a similar direction. Thus, when the right ureter is being viewed the interureteric bar and right border of the trigone will be seen to rotate about the ureteric orifices as a centre, although this centre will travel toward the observer's right.\*

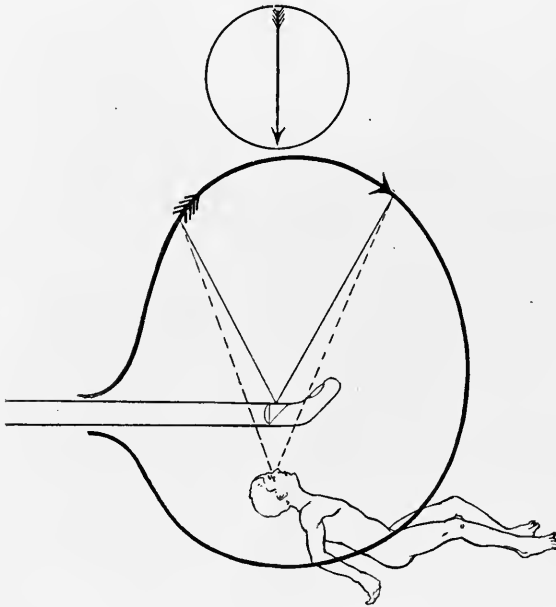


FIG. 51.—Inversion of the field when the beak is turned upward; the near point occupies the upper portion of the field.

With the cystoscope looking at the floor of the bladder (Fig. 52), depression of the ocular (cradle movement in a sagittal plane) imparts a downward motion to the object. This is tantamount to advancing the instrument, except that the details of the field will become smaller, and the illumination will become poorer (Figs. 53, 54 and 55).

**Magnification.**—To produce enlargement the ocular must be moved so as to approximate objective and outer field. The ocular must go upward in viewing the floor, downward for the roof. Such rocking motions tend also to throw objects out of the field, depression of the

\* The opposite motion will be conferred upon the field by rotation of the instrument to the left.

beak toward the floor having the effect of withdrawing the instrument. Hence, to compensate, slight intrusion of the cystoscope is necessary.

**The Problem of the Sphincter.**—Here, three disturbing factors are encountered; the proximity of lens and field, the great enlargement, and the difficulty of obtaining adequate illumination. The concave

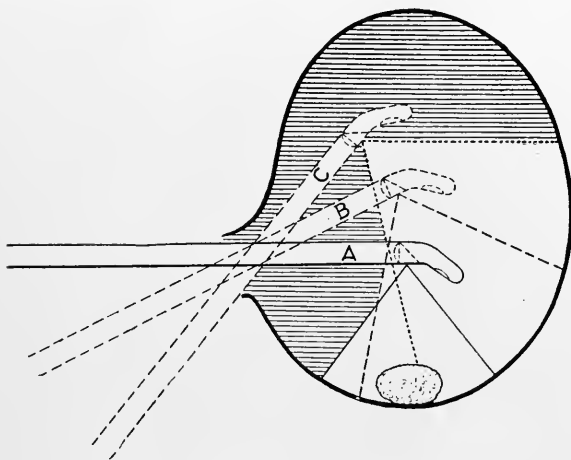


FIG. 52.—Induced movement of the field by depressing the ocular when a stone on the floor of the bladder is being inspected.

sheath is inferior to the convex here, since the lamp of the latter can be brought into better relation with the juxtasphincteric and urethro-sphincteric regions. The cysto-urethroscope gives the best picture here.

The roof and sides of the internal sphincter normally present a concave line, that portion of the bladder occupying the concavity being darker because the illumination is inadequate (Fig. 56). The floor is

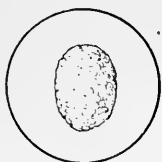


FIG. 53.—Stone is in the centre of the field.

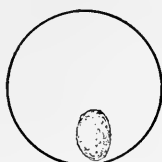


FIG. 54.—Stone has moved downward and is smaller.



FIG. 55.—Stone is almost out of the field and is still smaller.

somewhat convex. These concave and convex lines represent the margin of the sphincter in the direction of an approximately horizontal plane. Any abnormality in this plane, such as intravesical intrusion due to prostatic adenoma (hypertrophy) will alter the concave to a convex line. In the vertical plane outgrowths are difficult to estimate, since they will have no other effect than one of magnification.

**Light.**—The quality, intensity, and position of the light will vary according to type of lamp, three forms being in use: with the lamp in the concave sheath, in the convex sheath, and in the cysto-urethroscope. The illumination varies also with the distance of the lamp from the field; and finally it will depend upon the relation of the lamp to the mucous membrane, being modified by the presence of tumors, foreign bodies (calculi, etc.), and the displacements produced by extravescical causes.

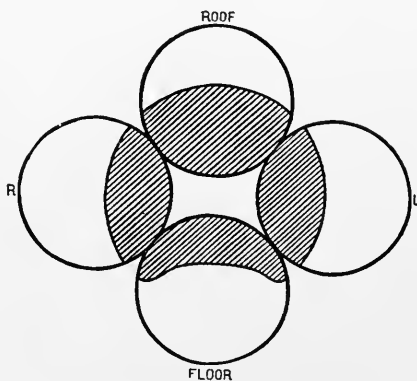


FIG. 56.—Diagrammatic drawing showing the view obtained at the sphincter, the roof, the floor, the right and left side being shown.

Up to a certain point approximation enhances the intensity of the light, but when the lamp comes too close to the mucous membrane, illumination diminishes, particularly when the lamp is in contact with the mucous membrane. Then transillumination and shadow formation occur.

When the cystoscope is too far back in the bladder (Fig. 45) the lamp becomes covered by mucous membrane and the light is shut off. A tumor may throw a shadow by obscuring the light, so also a calculus, as well as an enlarged uterus, a myoma, or a tumor outside of the bladder. Prostatic adenoma ("hypertrophy") leads to the formation of a retroprostatic pouch and prevents the approximation of the beak and mucous membrane so that light is diminished. So also do prolapse of the uterus and cystocele interfere with illumination. Some of these conditions can be overcome by compensating movements of the instrument by pressure over the abdominal wall or by manipulation of the vaginal wall in the case of cystocele.

### URETERAL CATHETERIZATION.

**Technic with the Indirect Cystoscope.**—The technic with the Buerger cystoscope will be described, since this is commonly employed.\* In the majority of cases, synchronous ureteral catheterization is advised, since the collection of urine simultaneously from both kidneys is

\* In the United States.

invaluable in determining the relative function of the two organs, aided with the use of such tests as the phenolsulphonephthalein and indigo-carmin and the chemical microscopic and cultural examination of the separated specimens.

The catheterizing telescope is armed with two No. 6 French ureteral catheters; the sheath, observation telescope, and obturator having been

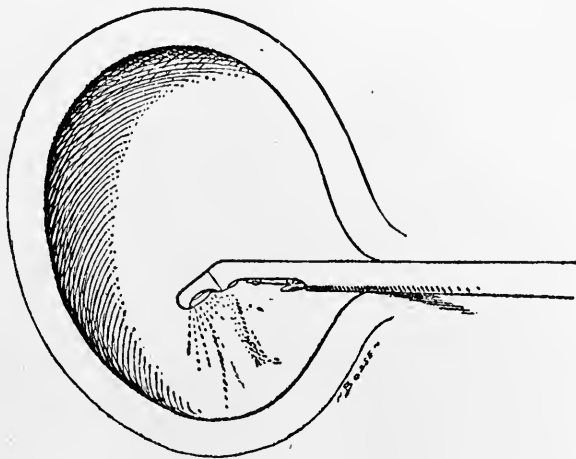


FIG. 57.—Normal ureteral catheterization. First move. Cystoscope in normal position.

also prepared. After observation cystoscopy has been completed, we proceed to the catheterization of the ureters as follows:

1. The ureteral opening is found and the ocular end of the cystoscope is brought slightly to the opposite side of the patient. By raising the shaft the ureteral slit is made to occupy a point just above the



FIG. 58.—Cystoscopic view in first move: the ureter slightly above the centre of the field.

centre of the field. *This position must be rigidly maintained during the next two steps.* The ureter orifice should be about normal in size, or but slightly enlarged, which can be expected at a distance of about three quarters to one inch (Figs. 55 and 58).

2. After the deflector has been slightly raised (just sufficient to prevent the catheter from hugging the lens) the catheter is pushed for-

ward almost 1 cm. beyond the limit of the field. Now the catheter appears enlarged, for it lies close to the prism (Figs. 59, 60 and 61).

3. The deviation is gradually increased by raising the deflector, the movement of the catheter in the field being observed during the pro-

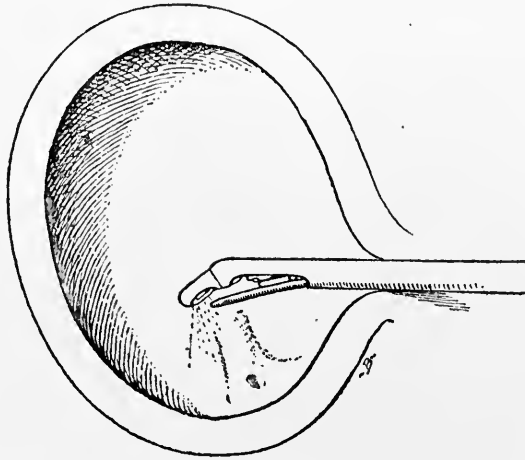


FIG. 59.—Normal ureteral catheterization. Second move. The tip of the catheter lies beyond the field.

cedure. The tip of the catheter now comes into view, first appearing at the top of the field and gradually traveling downward, its size diminishing at the same time. *When its tip is a short distance below the ureter, it is usually in the proper position; in reality it then lies in front*

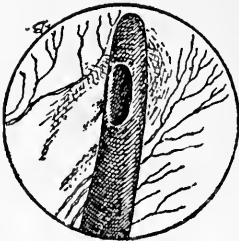


FIG. 60.—Cystoscopic view. The catheter is being pushed across the field.

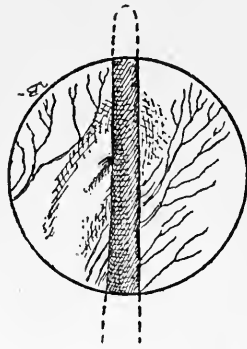


FIG. 61.—Cystoscopic view: the catheter lies beyond the field; view seen in Fig. 59.

(nearer the neck of the bladder), below and slightly to the inner side of the ureteral mouth (Figs. 62 and 63).

4. By now raising the shaft of the instrument, and at the same time passing it farther into the bladder, the tip of the catheter is made to

enter the mouth of the ureter. Therefore the cystoscope and catheter as a whole travel toward the opening and not the catheter alone (Figs. 64 and 65). In the picture we see the ureter descend to meet the catheter

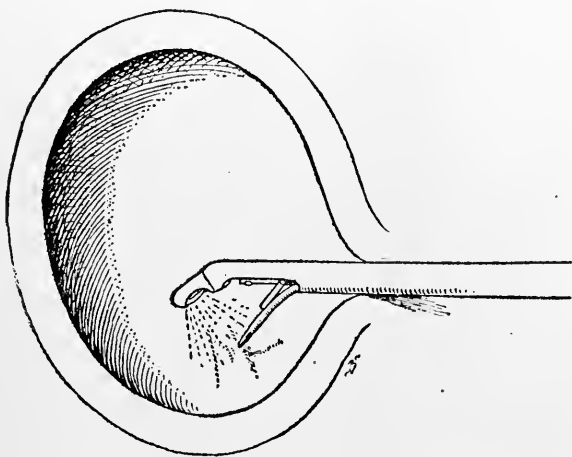


FIG. 62.—Normal ureteral catheterization. Third move. Catheter has received its full inclination.



FIG. 63. — Cystoscopic view. The catheter tip lies just below the ureteral opening; view seen in Fig. 62.

ter at about the middle of the field. When the catheter has engaged the ureteral opening, it is pushed a short distance forward, the deflector is depressed somewhat, and, by still further raising the ocular, the

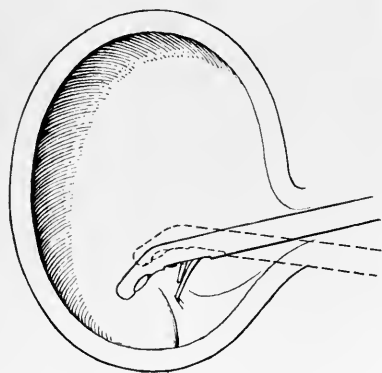


FIG. 64.—Normal ureteral catheterization. Fourth move. The tip of the catheter is made to enter the ureter.

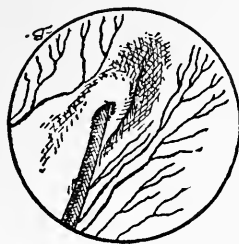


FIG. 65. — Cystoscopic view. Catheter has entered; view seen in Fig. 64.\*

introduction of the catheter becomes easy. The lid (deflector) is now turned upward, the other ureter sought, and the method repeated.

Although the above may be considered as a "normal" method, certain variations in technic will be required in difficult or anomalous cases.

\* Note that through an error the ureteral orifice has been drawn too high in the field, since it must occupy a lower position than in Fig. 57 after the instrument has been pushed inward. Cf. with Figs. 51, 52, 53 and 54.

Thus we may find it advantageous to change the amount of deflection or to retain the maximum deviation while pushing the catheter along the ureteral canal. If we see that the bladder wall is being raised considerably by the entering catheter, we know that the anterior wall of the ureter is being lifted up by the catheter. This occurs especially when stiff catheters are used and when the deflector has been turned down too far, for in both instances the catheter has a tendency to seek a higher level, one approaching the plane of the shaft of the instrument. To overcome this, three maneuvers are permissible, either raising the ocular so as to bring the catheter more nearly in the direction of the urethral canal or increasing the deflection, or a combination of both.

If carefully carried out, this procedure is far superior to that by which the catheter is "aimed" at the opening and pushed out to meet it. It affords a more certain way of hitting the mark, avoiding scraping of the bottom of the bladder, and is easy of execution.\*

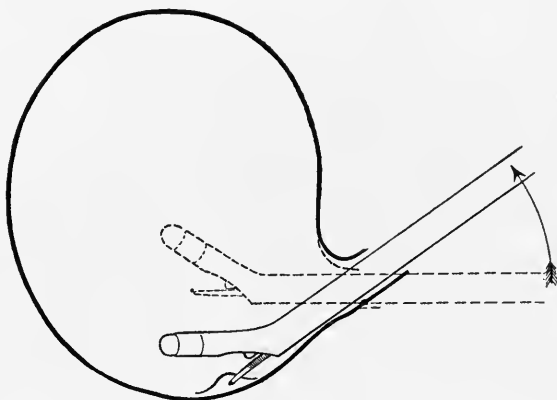


FIG. 66.—Catheterization with the direct cystoscope.

**Technic with the Direct Cystoscope.**—In our experience the direct method of catheterization is far inferior to the indirect. The direct cystoscope will practically never be found necessary for ureteral catheterization.

After introduction of the instrument, the obturator is removed and the bladder irrigated. The telescope armed with two catheters is then introduced and boric acid solution allowed to enter. The trigone is then inspected, it being remembered that the instrument looks directly forward and that the intravesical portion of the instrument necessarily comes into contact with the trigone. The latter, therefore, appears considerably enlarged and is distorted by virtue of the fact that the plane of the field lies in the axis of the instrument (Figs. 35 to 38). When the ureter is recognized, the ocular end of the instrument is raised somewhat and the catheter introduced into the direction of the

\* For those who catheterize at close range, particularly when the convex sheath is used, the method described need not be followed.

canal (Fig. 66). The instrument is then turned to the opposite side, an attempt being made to follow the interureteric bar, and the other ureter recognized and catheterized.

**Technic with the Elsner-Braasch Cystoscope (or Endoscope).\***—In the hands of a few experts this method still finds application, but is not recommended for the average cystoscopist because the view is too limited; thorough inspection of the bladder is impossible; observation cystoscopy necessitates wide excursion of the ocular end of the instru-

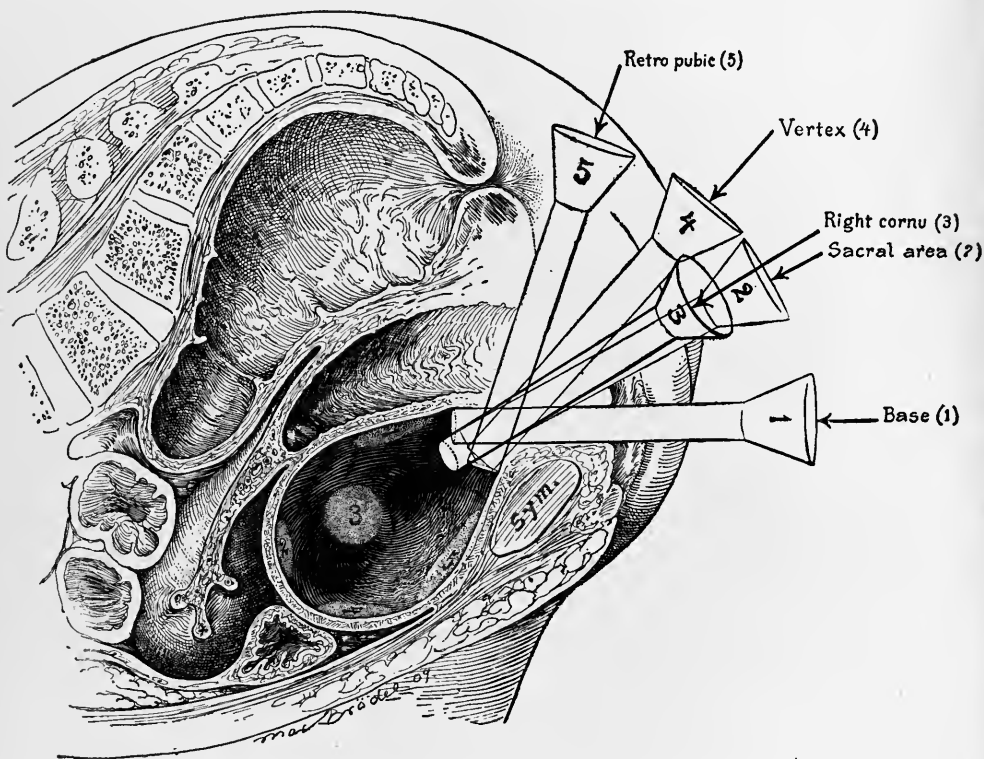


FIG. 67.—The position of the Kelly endoscope in viewing the bladder. (After Kelly and Burnam.)

ment; the procedure is much more painful and disagreeable than the indirect method; in difficult cases the finding of the ureters takes a great deal more time and is not as certain as with the indirect method; the acquisition of the requisite technic is painstaking and success with the method is relegated to a very few.

As for the technic, the instrument is introduced with the obturator removed, the bladder irrigated, and the ocular end is closed with a glass window. Through an irrigating cock a continuous flow of boric acid solution bathes the telescopic tube and enters the bladder. The

\* For those who occasionally use this method, the Buerger universal cysto-urethro-scope will be found just as serviceable.

operator looks through the glass window, inspecting the trigone, and by a lateral motion brings the ureteric orifice into view. The catheter is then put into the corresponding catheter canal and introduced into the orifice under the guidance of the eye.

**With the Kelly-Pawlik Endoscope.**—A method for direct examination of the bladder first adopted by Kelly and Pawlik was described by H. A. Kelly as the *aërocystoscopic method*<sup>9</sup> (Fig. 67). In this method, distention of the bladder with air is induced by posture. A simple speculum or urethroscopic tube is introduced and located by withdrawing the speculum until the internal urethral orifice is seen. It is then carried in a short distance and pointed from 20° to 30° to one or the other side, the base of the bladder being viewed. With the orifice in view a ureteral catheter provided with a stylet is held in the right hand for catheterization of the left ureter, in the left hand for entering into the right ureter. The stylet is then removed. If we wish to catheterize both ureters, the speculum is withdrawn, reinserted, and the same maneuvers carried out for catheterization of the other ureter.

**Luys's Method.**—Luys recommends his modified endoscope or urethroscope for catheterization of the ureter of the male, employing an exaggerated Trendelenburg posture. The bladder is kept dry by continuous suction through a special canal in the endoscope. This method will be found too difficult and uncertain for anyone but the expert.

### OPERATIVE CYSTOSCOPY.

In this we include all those special diagnostic and therapeutic manipulations that can be carried out through a catheterizing cystoscope or through an operative cystoscope. The Buerger and Lewis operating cystoscopes are the simplest and used most widely in the United States. The Nitze and Kuttner cystoscopes are employed on the Continent.

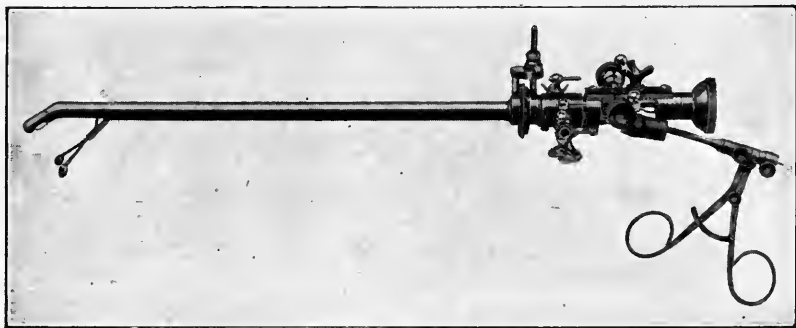


FIG. 68.—Buerger operating cystoscope with forceps of the recessive type in place.

**The Buerger Operating Cystoscope.**—The instrument resembles the catheterizing cystoscope, but its sheath is elliptical and its telescope provided with but a single outlet (Fig. 68). Concave and convex sheaths are provided and telescopes for giving either a right-angled

view, an obliquely forward view, or a slightly retrograde view, depending upon the region to be attacked. The right-angled telescope will suffice for almost all cases.

**The Buerger Combination Operating Cystoscope.**—This instrument at first glance indistinguishable from the others, offers the possibility of introducing examining, catheterizing and operating telescopes into the same specially designed sheath. As far as the requirements of observation and operating cystoscopy are concerned, it is identical with the catheterizing cystoscope. For operating purposes it is usually adequate, although it carries slightly smaller operating devices.

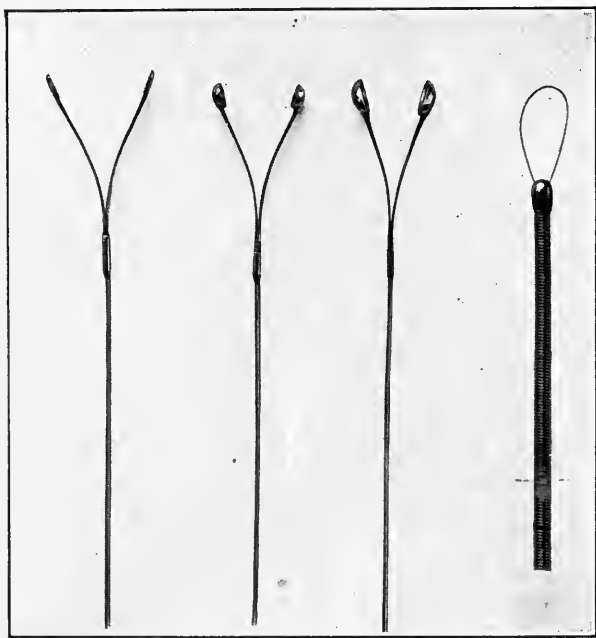


FIG. 69.—Working ends, operating forceps and snare.

**The Operating Instruments.**—Two varieties are available, the *recessive*\* and *non-recessive* or scissors type. In the first the general assembly includes a shank carrying the special working ends or jaws (Fig. 69), a flexible spiral cannula and a handle. The distal extremity of the cannula is reinforced, serving for the closure of the jaws of the instrument. By means of a universal scissors type of handle the jaws are drawn into the cannula and thereby made to close (Fig. 70). In the second type of operating instrument the closure of the jaws is brought about by a scissors mechanism which obviates recession of the jaws as they shut (Fig. 71). *Grasping, cutting, biting forceps* and *scissors* for cutting the ureteral orifices are provided.

A very useful and simple instrument is a *snare*, which comprises a spiral cannula whose distal end is capped with a solid metal knob con-

\* This type has been found less generally useful than the scissors type, the latter being recommended.

taining two perforations for the emergence of the wire loop and whose proximal end is fitted with a catheter channel which may be closed by a rubber tip.

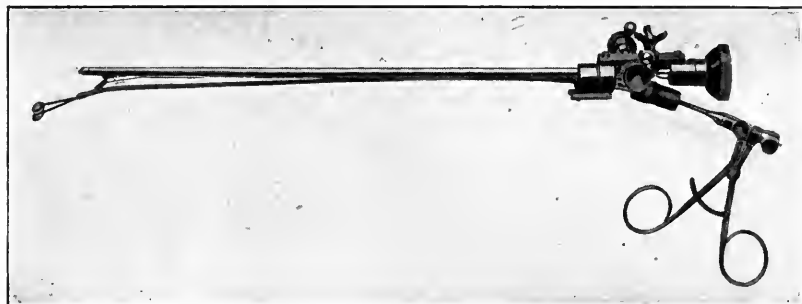


FIG. 70.—Operating forceps in telescope.

Besides, bougies for dilatation of the ureter a special bougie through which the d'Arsonval current may be applied will be found useful. A No. 9 French silk ureteral catheter serves to insulate a wire conductor, the proximal end of which has a coupling for attachment to the high-

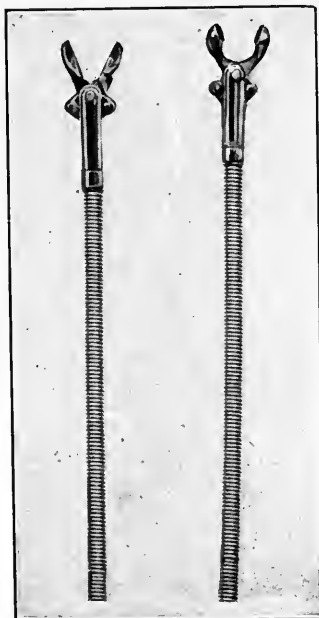


FIG. 71.—Scissors type of operating forceps.

frequency machine, the distal end being provided with a screw thread. To the latter, metal olives of various sizes are attached in sizes from 6 to 16 French.

**The Technic of Operative Cystoscopy.**—In the Buerger instrument it is possible to employ operative instruments of much greater size than the catheter outlet would seem to allow by a retrograde insertion of the working devices. All of the larger instruments must be introduced somewhat in advance of the telescope so that they may pass through the telescope alone, emerging through the fenestra before the telescope is locked home.

**1. Technic with the Recessive Type of Instrument.**—The operating telescope is prepared as follows: The cannula provided with a rubber nipple is introduced into the telescope through the catheter outlet until its extremity lies about 1 cm. beyond the lens prism. A suitable working end with its shank is now inserted in reverse fashion and the handle securely attached.

After introduction of the sheath and thorough inspection with an observation telescope, fitted to the operating sheath, the operating telescope armed with the instrument selected is introduced as follows: The working end with jaws closed enters in advance, and, if it is somewhat too large to escape at the fenestra in all possible positions, may be made to emerge by slight motions of rotation or with the aid of slight deflection of the lid. With the bladder filled, the lesion or foreign body is located. The cannula is pushed inward for the requisite distance, the jaws are opened, and by a combination of movement of the cystoscope and deflector the part to be attacked is readily seized. To overcome recession of the jaws the cystoscope or cannula must be pushed inward slightly as the jaws are made to close. Small bodies, tissue, and tumors are easily extracted through the sheath, the telescope and operating device being removed together. In extracting larger bodies, such as a ureteral calculus or foreign bodies, the cystoscope is withdrawn first, the forceps following.

If it is desired to replace the particular operating device just used with another, the telescope is withdrawn, the jaw with its shank removed and another inserted, the cannula and handle remaining undisturbed.

**2. Technic with the Scissors Type.**—After being provided with a suitable tip or nipple the operating instrument (forceps or scissors) is adapted to the sheath by being passed through the catheter outlet. Larger jawed instruments must be inserted in the manner described as suitable for the recessive instruments. The technic is the same as recounted above, except that it is unnecessary to move cystoscope or cannula while the jaws close. It is best to open the jaws before deflection, since bending of the cannula interferes with easy working of the instrument. Whenever small devices are needed the scissors type is recommended; when larger forceps for removal of foreign bodies, as ureteral calculi, are required, the recessive type is preferable.

**Methods in Operative Cystoscopy.**—**The Diagnosis of Ureteral Calculi by Means of Wax-tipped Catheters.**—This method of detecting a calculus in the ureter through scratch marks left upon the surface of a wax-tipped catheter was first suggested by Kelly, of Baltimore. In females there will be no danger of producing adventitious scratch marks, if the Kelly endoscope is used. In the male,

when the direct cystoscope is employed, the following special technic must be observed: Either the catheterizing cystoscope or the operating cystoscope is selected, preferably the latter. A No. 5 French olive-tipped ureteral catheter\* is prepared by dipping the tip into a mixture of equal parts of paraffin and beeswax. On withdrawal from the mixture a small fusiform mass of hardened wax remains. The following technic† is to be followed in the male. After irrigation of the bladder with a catheter a sterile wax-tipped catheter is introduced through the urethra and made to coil up in the bladder. The sheath of the cystoscope is then threaded over it and then the catheterizing telescope is inserted, the butt end of the catheter being passed in retrograde fashion through the catheter outlet. The bladder is then filled and, under the guidance of the eye, the redundant portion of the wax-tipped catheter is slowly withdrawn, care being taken that the wax portion does not come into contact with metal or with the deflector. Catheterization of the ureter and exploration of the same are then done. Finally, the instrument is withdrawn first, the catheter following. A search for scratch marks is then made with a pocket lens. Hinman has recently described an ingenious rubber sheath which protects the wax-tipped catheter as it glides through the operating cystoscope.<sup>3</sup>

In the female it will be found easiest to insert the wax-tipped bougie through the urethra, thread the sheath over it, and then follow with the catheterizing telescope.

Or if the operating cystoscope be not at hand, the following technic is applicable: After introduction of the sheath the wax-tipped bougie protected with a rubber tube (which projects 1 cm. beyond the wax tip), is made to enter and manipulated until tube and bougie emerge through the fenestra. The bougie is then pushed a little farther into the bladder, the rubber tube withdrawn and the telescope inserted.

**Special Catheterization.**—The synchronous employment of three catheters or bougies is possible in the operating cystoscope, and useful in cases of reduplication of the ureters. A very large catheter of the Garceau type may be useful in pyeloradiography and for drainage of a pyonephrotic kidney. Special catheters with bulbous enlargements to prevent reflux can be introduced through the operating cystoscope, and are valuable in pyelography.

**High-frequency Treatment of Tumors.**—This can be carried out through the catheterizing cystoscope, operating cystoscope or cystourethroscope. For the employment of this method of treatment which has been variously termed desiccation, fulguration, electro-coagulation, cauterization, intravesical cauterization, Beer made use of an insulated wire electrode which can pass through the cystoscope and be made to discharge the current from a high-frequency machine.‡ Although the

\* Long whalebone filiforms are useful but more rigid and less easily handled.

† Since the introduction of the Buerger operating and combination cystoscopes, it is an easier procedure to guard the wax-tipped bougie with a rubber tube placed in the operating telescope.

‡ Standard Nos. 2 and 3 made by Wappler Electric Manufacturing Company, catalogue No. 56, pp. 41 and 42.

exact nature of the effect of the electric sparks upon the tissues is not clearly understood, we may regard destruction of the tissues that ensues as equivalent to cauterization. Two types of current, the Oudin or monopolar, and the d'Arsonval or bipolar current give almost identical results. This procedure is applicable only in benign growths, particularly to papillomata, and must not be carried out until the exact diagnosis has been made with the microscope. For this purpose a portion of the tumor should first be removed with the snare or with the punch forceps through the operating cystoscope. Carcinomata do not respond, except perhaps for those small papillomata in which a change into carcinoma is just beginning to take place. When used through the cysto-urethroscope and operating cystoscope, special electrodes covered with silk and shellac insulation will be found more durable than the rubber-insulated wire first suggested.

**Dilating of the Ureters and Facilitating the Descent of Ureteral Calculi.**—For strictures of the ureter, abnormally narrow ureteric orifices, occasionally inflammatory conditions of the ureter due to calculus, and particularly for the purpose of expediting the descent of descending ureteral calculi, the dilatation of the ureter may be practised. With the operating cystoscope, we begin with a small catheter or small bougie, No. 5 French or less, then insert a larger one, or two or more catheters or a large bougie. Somewhat more certain and effectual is the employment of graduated metal olives at the end of a bougie electrode, through which the d'Arsonval current may be applied.<sup>1</sup> Detachable metal olives are screwed on the end of an insulated wire electrode. These can be introduced after the fashion of a ureteral catheter. With a large indifferent electrode over the lower abdomen, the second pole being the metal olive, a current of 200 to 400 milliampères is allowed to pass, while gentle pressure is exerted against the point of ureteral obstruction. Often the obstruction gives way after a few seconds' contact. The small olive (beginning with No. 5 or 6) is then removed, and a larger one inserted, the process being repeated until adequate dilatation has been produced. When using the larger olives, it is important that the olive protrude beyond the objective and enter the sheath first, or else introduction into the sheath will fail. In many cases of descending ureteral calculi a small stone will be made to pass shortly after dilatation by this procedure. This may be combined with the injection into the ureter of olive oil or glycerin and the employment of the current is not always essential. When the ureteric orifice is not too small, the procedure may be preceded by meatotomy of the ureter.

**The Removal of Foreign Bodies, Calculi and Phosphatic Encrustations.**—The technic of the removal of foreign bodies with the operating cystoscope will depend upon their size, structure and shape. We must be guided in the selection of the type of forceps by these considerations. When the body is too large to pass through the sheath, which is often the case with descending ureteral and also vesical calculi, the forceps with body in its grasp is first pushed farther into the bladder beyond the beak. The cystoscope is then rotated so that its beak points up-

ward,\* and the cystoscope, forceps, and body are removed simultaneously, the foreign body being the last to appear from the urinary meatus. For the removal of phosphatic encrustations in alkaline and ulcerative cystitis, the operating punch forceps or a special curette will be found invaluable in clearing up an otherwise intractable cystitis. The sheath must remain *in situ* while the encrustations are removed piecemeal.

**Ureteral Meatotomy.**—This may be necessary as a preliminary procedure before dilatation of the ureter to facilitate the passage of a calculus; also in cases of congenital stenosis of the ureter. Special scissors are used to cut the upper ureteral lip.

**Exploratory Excision (Intravesical Biopsy).**—We are not infrequently confronted with alterations of the vesical mucous membrane, whose exact nature is doubtful. For the diagnosis of certain cases, excision of lesions followed by microscopic examination may be indicated. In the case of suspected carcinoma the removal of adequate pieces, preferably from the periphery of the growth, is absolutely imperative. In the cases of suspected renal tuberculosis when there are early changes, such as edema and polypoid protuberances in the neighborhood of one ureteral orifice, excision of tissue from the ureteral lip will disclose miliary tubercles under the microscope. When tubercle bacilli are not found, we often can make a diagnosis in this way.

**Snaring of Papillomata.**—Experience<sup>6</sup> has shown that carcinoma must be ruled out in the case of all papillomata by means of histological examination. Whenever feasible, therefore, a large part of the growth should be removed with the intravesical snare. This can be readily accomplished when the tumor has attained sufficient size and lies in accessible portions of the bladder. In certain positions, such as the immediate neighborhood of the sphincter, the snare is not applicable. Here the removal of material by means of the punch forceps through the operating cystoscope or operating cysto-urethroscope must be substituted. The snare is provided with a loop of No. 00 piano wire, which is developed by pushing out one and then the other of the wires. The tumor is encircled, the end of the cannula being carefully held against the pedicle lest the papilloma elude the grasp of the loop as it is being drawn tight. Because of the peculiar villous nature of these growths, tumors of considerable size can be forced through the sheath of the operating cystoscope.

**Excision of Ulcers.**—Callous ulcers of the bladder, particularly in females, and foci that are covered with phosphatic encrustations, when these cause an irritable bladder, should be treated with excision with the punch forceps.

**Operations on Ureterocele and Cystic Bodies.**—When there is an anomalous or congenital stenosis of the ureteric orifices, or when there is a condition of cystic dilatation of the lower end of the ureter, incision with a special intravesical knife or with cystoscopic scissors, combined with the use of the punch forceps, may completely abolish the cause of the obstruction and make for drainage of the kidney.<sup>4</sup>

\* Rotation is unnecessary if a convex sheath is employed.

### URETHROSCOPE AND URETHROSCOPY.

Urethroscopy deals with the inspection of the male and female urethra in their entirety. In the male we may arbitrarily divide the urethra for purposes of urethroscopy, into the anterior urethra, the posterior urethra and the urethrovesical or sphincteric portion. In the female we may divide the canal into the urethra proper and the sphincteric or urethrovesical portion.

The anterior urethra may be brought into view in two ways: directly with the urethroscope, also called endoscope, and indirectly with telescopic instruments.

The posterior urethra may be viewed directly by endoscopes of the straight or curved variety, indirectly by means of a cysto-urethroscope.

The sphincter or urethrovesical portion in the male may be poorly and inadequately viewed by means of the direct method, thoroughly inspected by the indirect method through the cysto-urethroscope.

### THE URETHROSCOPE.

The simplest and most useful instrument for viewing the anterior urethra is a tube into which light can be thrown either from without by means of a small electric lamp or from within by means of a light carrier introduced into the tube (Fig. 72). A small magnifying lens is invaluable to enlarge the picture. A set of tubes in sizes of 20, 22, 24, 26, 28, and 30 French should be available, Nos. 24, 26, and 28 being the most frequently used. Although this instrument will suffice for routine work in the anterior urethra, the cysto-urethroscope is employed by many for a study of those finer details that may escape observation by direct vision.

**Technic of Urethroscopy.**—The patient is placed either in the dorsal decubitus with the operator standing on his right or in a modified lithotomy position with the thighs horizontal, the legs vertical, and the feet supported upon a rest, in which case the operator stands between the patient's thighs. The former position will be found convenient for the inspection and treatment of the anterior urethra.

The set of urethroscopes having been boiled, the lamp having been tested, the operator selects a tube of ample size, preferably 24, 26, or 28 French. If the meatus is too small, meatotomy may be done. After cleansing the foreskin and meatus the left hand holds the penis, while the endoscope with the obturator in place, previously lubricated, is allowed to find its way into the urethra, until it is arrested at the bulbomembranous junction. The obturator is removed, the urethra and tube mopped dry by means of sterile cotton applicators, the light applied, the lens adjusted, and the urethra is ready for view. The left hand continues to hold the penis while the right hand gradually withdraws the endoscope.

In most cases local anesthesia is not recommended for simple observation urethroscopy, because it may produce anemia of the mucous mem-

brane, and may wash away secretions whose source is to be determined. If painful operative procedures are to be done, a 2 per cent, or 4 per cent, novocain solution is injected and allowed to remain in contact with the urethra for five minutes.

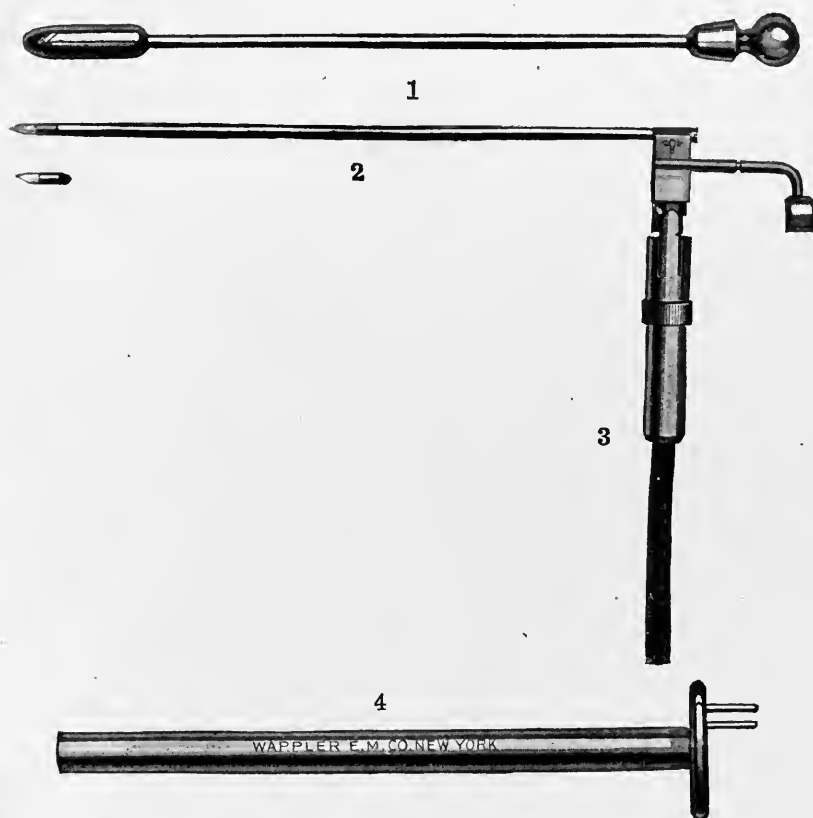


FIG. 72.—Urethroscope for viewing the anterior urethra: 1, obturator; 2, light carrier with small lens attached; 3, electric coupling and cable; 4, endoscopic tube.

**Urethroscopic Picture.**—The essential features of the urethroscopic view are the character of the central figure and of the mucous membrane. The *central figure* is that artificial termination of the urethral canal produced at the far end of the urethroscope. By virtue of the distending effect of the endoscope the urethral walls are symmetrically separated at the level of the end of the tube and present, in their gaping condition, a funnel whose outlet is made up of the centre of the urethral canal (the central figure) and whose walls are the mucous membrane immediately in view. The shape of the central figure will vary in different parts of the canal, being a vertical slit in the region of the glans, being punctiform in the penile urethra, and becoming a more or less transverse crevice farther down in the canal.

The surface of the mucous membrane presents for consideration the *longitudinal folds*, *longitudinal striæ*, the *lacunæ of Morgagni*, and the *glands of Littre*.

The longitudinal folds by virtue of their disposition may be likened to the spokes of a wheel and become considerably altered by pathological changes in the mucous membrane.

The longitudinal striations are the consequence of vascular ramifications, and are seen as red converging markings on a paler, yellowish-red background. The surface of the mucous membrane is smooth and shiny, any loss of brilliancy being evidence of pathological change. The lacunæ of Morgagni are crypts situated on the superior roof of the penile urethra, and their orifices can be seen as minute depressions whose color does not vary from the surrounding mucous membrane in the normal state. The larger lacunæ have orifices that are V-shaped, the point being turned toward the central figure.

The glands of Littre are very numerous and hardly recognizable except when they have undergone pathological change. The Cowper's glands are rarely visible in the floor of the bulbous urethra.

**The Pathological Anterior Urethra.**—As a result of gonorrheal inflammation, two broad types of lesions in the mucous membrane may result, "soft infiltration" and "hard infiltration."

**Soft Infiltration.**—This is characterized by a turgid condition of the mucous membrane, histologically by infiltration of the submucosa with round cells and increased vascularization. This condition results or accompanies acute urethritis, also the earlier stages of chronic urethritis. The mucous membrane is hyperemic, inflamed, turgid, and not unlike a group of hemorrhoids. The central figure is closed, the longitudinal striæ disappear, and the longitudinal folds are effaced.

The lacunæ of Morgagni and glands of Littre are usually involved, their glandular secretions being increased. The mucosa in the immediate neighborhood is a deeper red and slightly swollen, and the excretory ducts of the Littre glands are more prominent than normal.

**Hard Infiltration.**—This is distinguished by pallor of the mucosa, histologically by connective-tissue proliferation, the end-result of an exudative cellular inflammation. This corresponds to the condition of "stricture of large caliber" described by Otis. The urethroscopic tube meets with a certain resistance in its passage through such a urethra. The walls present a characteristic rigidity, having lost their normal suppleness. When the endoscope is withdrawn the central figure gapes and the eye may look down much farther than in the normal case. There is notable diminution in the coloring of the mucosa, pallor, a grayish-yellow color or even a whitish-gray appearance.

**Lesions in the Lacunæ of Morgagni and Littre's Glands.**—Two types of lesions must be recognized, the glandular form, or open lesion, and a dry or follicular form, the closed lesion.

**Glandular Open Lesions.**—Here the orifices of the glands of Littre are enlarged and surrounded by an inflammatory zone. A drop of secretion, sometimes purulent, sometimes clear, may be seen emanating from

the orifice. Similar changes are seen about the lacunæ of Morgagni. Their orifices are crater-like, and mucoidal or purulent secretion escapes.

**The Dry or Follicular Form.**—When the excretory ducts are closed, the glands become shut off and secretion accumulates so as to form cystic bodies which may harbor the gonococcus.

For the more rare lesions, such as ulceration, leukokeratosis, leukoplakia, syphilitic lesions, chancre, varices, new growths, papillomata, polyps, sarcoma, tuberculosis, etc., special works on urethroscopy should be consulted.

**Urethroscopy of the Posterior Urethra.**—The posterior urethra can be brought into view in two ways: directly, through a straight or curved urethroscopic tube, and indirectly, through a cysto-urethroscope carrying a telescopic lens system (Goldschmidt or Buerger).

**With Endoscopes.**—Two types of instruments may be used for this purpose: The straight tube employed for inspecting the anterior urethra, or the curved tube with a beak as suggested by Löwenhardt and modified by Swinburne. These instruments were much in use before the development of the cysto-urethroscope, and, although they still have a sphere of usefulness in the hands of those who frequently make topical applications, they may be regarded as being so greatly inferior to the cysto-urethroscope, that, in our experience, they need rarely be employed.

A useful type is that in which the lamp is carried in a special groove and does not encroach upon the lumen of the tube. When it is desired to look into the bladder also by direct vision, the Luys endoscope is recommended since the field can be kept dry by aspiration. Some urologists find an attachment for air inflation of the urethra of value.

**Technic.**—With the bladder empty and after the application of the local anesthetic, the patient is placed in either the lithotomy or modified lithotomy position, with the inclination of the Trendelenburg posture if the Luys tube is employed. In the female the knee-chest position is preferred by many. After the patient has voided, the urethroscope is introduced, the urine aspirated either through a special aspirator or through the canal in the urethroscopic tube or mopped out with cotton applicators, the lamp applied, and inspection is begun at the internal vesical sphincter. The urethroscope is withdrawn gradually, the posterior urethra being inspected as it prolapses into the lumen of the tube. It is difficult to avoid traumatism in these manipulations.

**With Cysto-urethroscopes.**—Since the introduction of the telescopic variety of instrument for viewing the posterior urethra the direct method has been discarded by a large number of urologists. In our own opinion a cysto-urethroscope is to be preferred both for routine examinations and for therapy, for the following reasons: it produces no trauma, may be easily introduced, and is very well borne by the patient; the view of the ureters, trigone, sphincteric, and juxta-sphincteric regions and posterior urethra is immeasurably superior to that obtained with any other system; by the use of a constant flow

of irrigating fluid that dilates the posterior urethra the to-and-fro as well as the rotatory motions of the instrument are facilitated, traumatism is obviated, pain is dispelled, the urethra is unfolded, and the thoroughness of inspection is enhanced; even the region of the neck of the bladder, almost inaccessible in a therapeutic sense through other instruments, can be attacked with ease; in the diagnosis of prostatic hypertrophy the cysto-urethroscope gives exact data obtainable with no other instrument.

*The Goldschmidt Instrument.*—This is made up of a sheath with a large fenestra whose width corresponds to the diameter of the sheath, necessitating the cutting out of one-half of the circumference of the tube. A non-prismatic telescope is introduced, the source of illumination being situated either in the beak or in the roof of the sheath. Although a fairly good view of the urethra is obtained with this instrument, objects must necessarily suffer considerable distortion, owing to the fact that the part to be seen is parallel with the axis of the telescope. Then, too, the source of illumination takes up a portion of the field, disturbing the picture. Wossidlo has modified this instrument so that the view and accessibility of the parts for treatment are enhanced.

*The Buerger Cysto-urethroscope.*—Two types of instrument are available, one for simple observation and another for special operative work, the optical principle involved being the same in both. In the Buerger cysto-urethroscope a true picture of the interior of the posterior urethra is obtained by a special lens system, which produces scant augmentation in the size of near objects, and looks downward at right angles upon the field.

The observation instrument (Fig. 73) consists of a sheath with a curved detachable beak, an obturator, and telescope. In the sheath there is a small fenestra, two irrigating cocks, and the source of illumination is a small lamp behind an obliquely set window, illumination coming from above. The telescope is provided with a single catheter outlet and deflector.

*Technic of Cysto-urethroscopy.\**—The sheath with obturator *in situ* is introduced into the bladder, the obturator removed, and if the contents of the bladder are cloudy, irrigation is carried out through the sheath. Otherwise the telescope may be inserted at once, an irrigator attached to one of the lateral faucets, and a constant flow of boric acid solution is allowed to pass through the sheath, being controlled with the finger of the left hand at the stopcock. The light is then turned on, the beak turned up, the lens looking downward. The trigone is first inspected; then the sphincteric margin is brought into view, the instrument being rotated on its long axis. The instrument is then gradually withdrawn and the posterior urethra examined as far as the membranous urethra. The instrument is then introduced again beyond the sphincter and the bladder emptied, if it is too full, either through the irrigating cock or by withdrawing the telescope. By rotation of the instrument the superior

\* With the Buerger cysto-urethroscope.

and lateral walls of the posterior urethra are now viewed. Finally, the membranous urethra and bulb are examined, and upon withdrawing the instrument the left hand firmly grasps the penis, so that an inspection of the anterior urethra can also be carried out.

In order to facilitate localization of the findings obtained with the cysto-urethroscope, it is expedient to divide up the posterior urethra in an arbitrary way, taking certain well-defined landmarks, such as the annulus urethralis, or margin of the internal sphincter of the bladder, and the colliculus seminalis, in determining the extent of each portion. The subdivisions that are most useful in practice are the following:

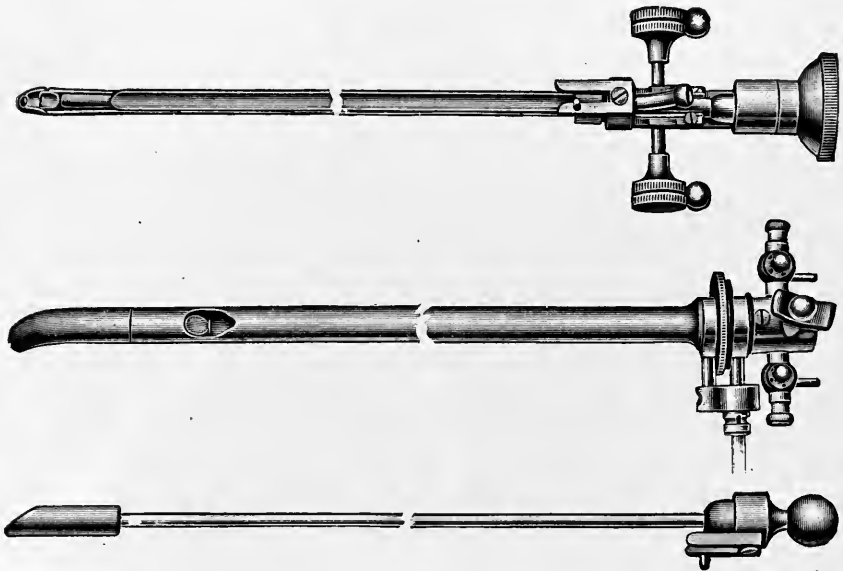


FIG. 73.—Buerger observation cysto-urethroscope.

The sphincter margin with superior (roof), inferior (floor), and lateral portions (sides); the pars prostatica (*C*) and the pars membranacea (*B*) (Fig. 74).

We divide the prostatic urethra into:

(1) Supramontane portion between the sphincter margin and verumontanum, with a roof, lateral walls (sides), and floor (*U*). (2) Montane portion with a roof, sides and floor (*T*).

The floor of the supramontane portion shows the fossula prostatica (*F P*) and the floor of the montane portion contains the colliculus (verumontanum or urethral crest) and lateral sulci (sulci laterales). If we regard the complete ridge or verumontanum as the urethral crest (crista urethralis) it seems best, for topographical reasons, to distinguish the following parts: posteriorly (toward the bladder) there are usually a number of small bands that lie in the fossula prostatica and pass into the crista urethralis, namely, the posterior frenula. They belong both

to the supramontane portion and to the montane. The crista shows a posterior gradual inclination or declive (*S*), a central prominence, or summit, and the anterior distal slope, the acclive (*R*). We shall drop the term urethral crest and speak only of a verumontanum or colliculus

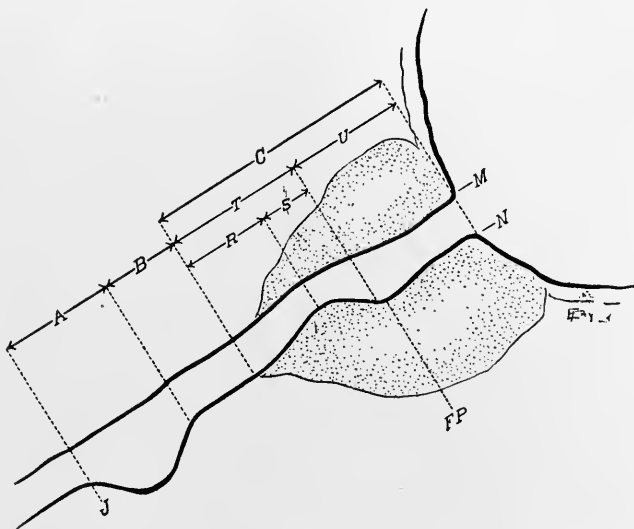


FIG. 74.—Diagrammatic subdivision of the posterior urethra, the membranous urethra, and bulb.

showing a summit, acclive (anterior crista), and declive (posterior crista). The valleys on either side of the colliculus are the sulci laterales.

The membranous urethra (*B*) receives the terminating fold of the acclive and also has a roof, side walls and floor.

**Normal Urethroscopic Picture (Posterior Urethra).—The Supramontane Region.**—The markings of the floor are prolongations of those of



FIG. 75.—Floor of the sphincter and supramontane urethra.

the trigone. The floor descends toward the periphery and terminates in the fossula prostatica. The mucous membrane of this region is of a deeper red than that of the roof and sides of the sphincteric margin. As for the markings, we usually find longitudinal vessels which show a

tendency to converge toward the periphery, taking their source from the sphincteric margin and passing toward the fossula prostatica (Fig. 75).

The side walls and roof present nothing worthy of note. The supramontane region contains a proximal and a distal portion. The proximal part corresponds to the true internal sphincter. Distally the floor of the pars supramontana contains the fossula prostatica, in which lie the

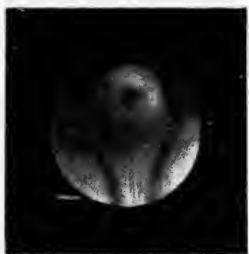


FIG. 76.—Normal type of colliculus (verumontanum), with large utricule.



FIG. 77.—Normal colliculus, showing three vertical slits, the utricule in the centre and the ejaculatory ducts on either side.

posterior frenula, tiny ridges which pass backward from the foot of the declive, diverging as they are traced backward toward the sphincter and varying both in number, in size and inclination.

At the level of the fossula prostatica we begin to meet with the larger, plainly visible prostatic ducts, that hide in the depression between the posterior frenula and at the foot of the declive.



FIG. 78.—Normal colliculus, showing the utricule, the ejaculatory ducts, the declive above, and the posterior frenula.

**The Montane Region.**—The verumontanum has a summit, a posterior portion or declive, and an anterior portion or acclive. The size of the verumontanum varies greatly. The general shape of the region, too, is subject to variation, insofar as it may sometimes show a deep concavity, and at other times seems to be almost filled by the verumontanum.

Types of verumontanum are illustrated in Figs. 76, 77 and 78. In

most the orifice of the utricle can be distinctly seen. It takes a median position not far from the summit, varying in general appearance, sometimes being punctiform, slit-like (Figs. 76 and 77), umbilicated, even of bizarre form. Commencing by a fine tapering extremity in the membranous urethra the urethral crest broadens in a triangular fashion as it ascends, becoming the acclive of the colliculus. In most cases the ejaculatory ducts can be made out as two symmetrically situated orifices somewhat below, distal and to either side of the utricle. They may be vertical slits or may resemble the prominent eyes of a frog when they occupy a more lateral position.

In the contracted state the color of the colliculus is a pale yellowish red. A change in color takes place when upon artificial irritation, traumatism, or psychical excitation this body becomes congested.

**The Sulci Laterales.**—Their depth varies considerably in different cases. It is in these sulci that we find a number of prostatic ducts varying from 2 to 6 sometimes in the form of tiny slit-like openings, and more frequently having a punctate shape. The mucous membrane here is also of pale reddish yellow and the vascular markings are in the form of irregular longitudinal streaks and tortuous delicate vessels.

As for the side walls, these offer very little of interest. In most cases there is a fairly abrupt rise from the sulci, and in other cases there is a concavity which is of a somewhat deeper red than the floor.

**The Pars Membranacea.**—As the instrument is withdrawn from the montane region with the fenestra turned downward the acclive can be followed by its tapering crest into the membranous urethra. The longitudinal markings are very distinct, as a rule, parallel or slightly converging vascular striations running distally on either side of the crest and gradually becoming lost in the floor of the membranous urethra.

The delicate median ridge of the acclive, as it becomes lost in this portion of the urethra, often shows a striking pallor at its summit or middle, due partly to the pressure effect of the instrument and possibly also to an avascular condition of the part.



FIG. 79. — Junction of the bulbous and pendulous urethra; the bulb is not properly illuminated.

**The Bulbous Urethra.**—The pars bulbosa may be so large that when distended with fluid its distance from the fenestra and lamp is considerable and illumination becomes diminished. The floor presents a corrugated appearance with occasional transverse folds. The roof and the sides do not present these plicæ. A useful and interesting distal landmark is afforded by the junction of the bulbous and penile urethra (Fig. 79). The transverse margin with the illuminated mucous membrane below presents the beginning of the

penile urethra. On either side the folded lateral wall and part of the floor of the bulbous urethra are seen, and the central upper dark region represents the poorly illuminated distended bulb.

**The Sphincter Margin.**—Three parts may be considered: the vesical part, which also belongs to the realm of the right-angled and retrograde cystoscope; the true margin, or ring; and the urethral portion. Owing to anatomical conditions it is impossible, in the male, to obtain a satisfactory view of a small zone adjoining the roof of the sphincter (the juxtasphincteric part of the bladder roof). The sphincteric margin, however, can be perfectly seen throughout. Our inability to depress the ocular of the instrument sufficiently makes it impossible to approximate the window of the instrument near enough to obtain a proper view of an area adjoining the roof of the sphincter. At the sides, however, this is easier, particularly if we allow the bladder to collapse. In examining the inferior aspect of the vesical portion of the sphincter we encounter no difficulty, for the transition from trigone to floor of the vesical sphincter is a gradual one, and there is no sudden drop or sudden concavity such as is characteristic for the roof and sides. In the female these obstacles do not obtain, the urethra being short and the instrument having perfect freedom of motion. In the picture of the floor (Fig. 75) there is an upper portion which is relatively dark and represents the poorly illuminated bladder. Below this is the beginning of the floor of the pars supramontana with its slightly convex margin, the internal orifice or floor of the sphincteric margin. The color of this part is a fairly deep red admixed with yellow, and the vascular markings run in a longitudinal direction with a tendency to converge toward the urethra. In the picture of the sides of the sphincter we note the absence of vascular markings and a relative pallor as compared with the floor. A slight concavity is the rule. The sides are usually counterparts (Fig. 80), but the roof of the sphincteric margin often represents a more acute angle.

**Pathological Lesions.**—Just a bare mention of some important lesions can be made here. A more complete description may be sought in special monographs.<sup>2</sup>

**Sphincteric or Urethrovesical Lesions.**—Cystitis colli, lesions of gonorrheal urethrocystitis, edema, leukoplakia, urethritis cystica (Fig. 81), cystitis proliferans, papillomata, anomalies, early incisure, and lobe formation indicating hypertrophy of the prostate, the tabs following healed proliferative processes—all these can be distinctly made out.

The *supramontane* region is the favorite site of urethritis proliferans, which is characterized by hypertrophy of the mucous membrane, bulbous knobs, thickenings resembling small cysts. Widely dilated crypts occur as a sequel of gonorrhea.

In urethritis chronica cystitica the formation of cysts or edematous bodies is common, and these may involve any portion of the supramontane or montane urethra. The cystic changes may be so extensive as to involve the whole of the fossula, even converting the verumontanum into a cystic or edematous mass (Fig. 82).

In the *montane* region the lesions of the verumontanum are important: hyperemia, swelling, distortion, excrescences, enlargement, a velvety appearance, absence of vascular markings, disappearance of the open-

ings of the ejaculatory ducts, while the utricle remains visible, etc. As a result of posterior urethritis, the mucous membrane of the verumontanum loses its smoothness, often developing cock's comb-like vegetations. Intense changes with conversion of the summit of the verumontanum into a deep crater (Fig. 83) and other distortions result from the rupture of abscesses.



FIG. 80.—Right margin of the sphincter.



FIG. 81.—Cystic changes at the right margin of the sphincter.

In our experience, enlargement, hyperemia, and inflammation of the colliculus are not as frequent as one would suppose from the writings of those who have relied upon direct endoscopic examination.

As a result of repeated instrumentation, traumatism, or chronic urethritis the verumontanum suffers marked alterations. A number of knob-like masses may be all that is left of it; peculiar bands may divide it into irregular portions, or it may almost completely disappear through atrophy.

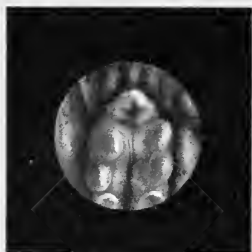


FIG. 82.—Cystic changes in the verumontanum.



FIG. 83.—Atrophy of the verumontanum with crater formation due to rupture of an abscess.

Deep scars in the montane (Fig. 84) and supramontane urethra are the sequels of instrumentation, perforation, and rupture of prostatic abscesses, traumatism and operations for stricture. Papillomata are not uncommon, particularly near the summit of the colliculus, and polyps of the lateral walls and membranous urethra are not rare.

In the *membranous and bulbous urethra* strictures of large caliber

with their transverse bands and ridges are frequently demonstrable. Stricture usually form shelf-like projections in the floor, sometimes extending over either lateral wall, with white crow's foot-like lateral offshoots.

In *prostatic hypertrophy* the cysto-urethroscope will demonstrate the very earliest submucous adenoma formations. The outline of the



FIG. 84.—A deep scar and large crypt in the right sulcus lateralis and distortion of the colliculus.



FIG. 85.—Floor of the sphincter in so-called lateral lobe hypertrophy (prostatic adenoma).

sphincter will present either an intrusion at the site of the submucous adenoma, or a distinct incisure, often at the floor, roof, or sides of the sphincter. Such clefts indicate the convergence of two contiguous adenomata or "lobes." As a rule, in cases of so-called "lateral lobe hypertrophy" the normal convex line at the floor of the sphincter is replaced by two distinct rounded bodies (Fig. 85). These can be traced into the supramontane urethra where they look like two

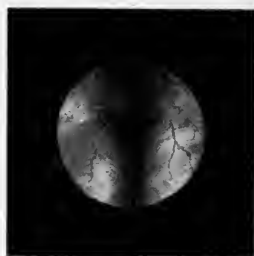


FIG. 86.—Lateral lobe hypertrophy in the supramontane region viewed with the cysto-urethroscope.



FIG. 87.—Lateral lobe hypertrophy: view just above the verumontanum; the latter is small.

large vocal chords, separated by a deep cleft (Fig. 86). Even the termination of these lobes in the membranomontane region can be found, and the verumontanum will appear much reduced in size (Fig. 87). A middle lobe may be combined with the lateral or may be present alone. Its presence is easily recognized at the floor of the sphincter.

**Operative Urethroscopy.**—This includes all therapeutic procedures that are applicable through either a urethroscope or cysto-urethroscope.

**In the Anterior Urethra.**—Very few instruments will suffice to do all the necessary therapeutic work in the anterior urethra. Cotton applicators, preferably on wooden handles, a fine probe, an electrolytic needle, a high-frequency applicator and an operative punch and alligator forceps should be available.

The lacunæ of Morgagni and glands of Littre may be destroyed either with the electrolytic needle or with the high-frequency electrode, the aim being to burn through the inner wall of the lacunæ or glands, so as to leave a wide avenue of communication with the urethral lumen, or to completely destroy the glands. Under special circumstances a small Kollmann knife may be of value in incising closed inflammatory foci.<sup>10</sup>

**In the Posterior Urethra.**—The straight urethroscope, the Swinburne, the Goldschmidt, Wossidlo, or the Buerger instruments may be employed.

Through urethroscopes (endoscopes) the following manipulations have been suggested: the application of silver nitrate in the strengths of 5, 10, 15 and 20 per cent. to lesions in the posterior urethra; cauterization of polypi and papillomata with galvanocautery or the high-frequency current; incision of cysts or closed suppurative foci with a knife; the injection of the utricle with silver solutions through a special cannula; and the removal of foreign bodies with forceps. All of these procedures can be carried out by experts, but will be found difficult of execution through mere endoscopes. Practically all necessary manipulations can be more easily learned and more precisely executed with the operating cysto-urethroscope.

**Operating Cysto-urethroscopes.\***—These are of two types, the indirect (prismatic) and direct (non-prismatic). The general construction (Fig. 88) of the indirect type is the same as that of the observation cysto-urethroscope, except that the fenestra and the catheter outlet are larger, both being ample for the insertion of operating devices. The lamp is arranged to give adequate illumination in the bladder as well as in the urethra. Synchronous catheterization of the ureters is possible, either through the operating telescope or through a special telescope† provided with two smaller outlets, and a fin to separate the catheters.

*Technic and Application.*—With the operating punch forceps the following therapeutic and diagnostic procedures are possible: (1) the removal of excrescences, inflammatory hypertrophies, and inflammatory polypi at the vesical sphincter and in the urethra; (2) the ablation of polypi and papillomata in the urethra of the male (this can be carried out in a few seconds and will be found much easier technically than through a straight tube); (3) the removal of pieces of tissue for diagnosis; (4) the opening of the superior wall of the utricle when this harbors inflammatory exudate, the injection of silver solutions being less efficacious; (5) the application of the high-frequency current through a special electrode‡ (the d'Arsonval current is preferred).

One of the most useful fields for the application of the operating cysto-urethroscope is in the treatment of papillomata at the sphincteric

\* Buerger Operating Cysto-urethroscope, Wappler Electric Manufacturing Company, catalogue 59, p. 11; and Buerger universal cysto-urethroscope.

† This may be obtained by special order from the Wappler Electric Mfg. Co.

‡ Bugbee electrode, Wappler Electric Manufacturing Company, catalogue 59, p. 16.

margin and for the diagnostic removal of pieces of tumor in this region. The application of medicaments to the posterior urethra through the operating cysto-urethroscope is carried out as follows: After the lesion is recognized the sheath is firmly held with the left hand in the position in which the lesion was found, while the telescope is removed and the fluid aspirated or mopped out of the sheath. Then the medicated applicator is introduced.

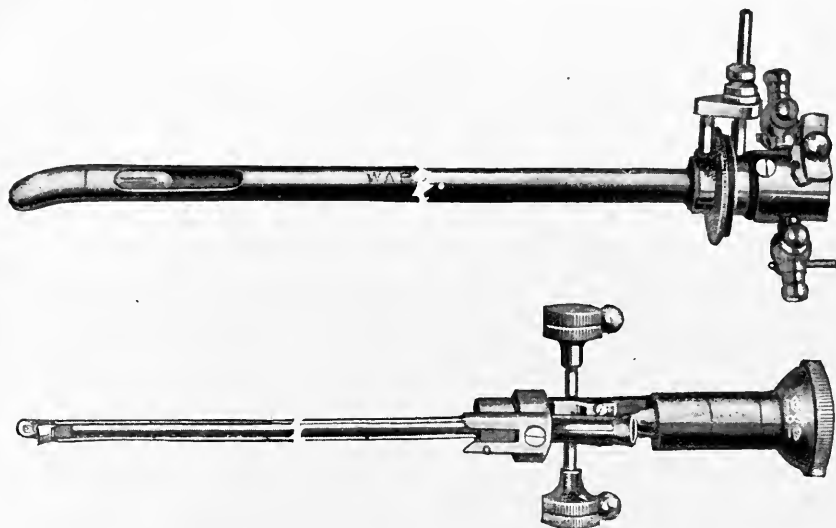


FIG. 88.—Buerger's operating cysto-urethroscope. This instrument has recently been constructed according to Buerger's specifications of a caliber equivalent to 21 French, a useful instrument in case of stricture and prostatic adenoma.

**Buerger's Universal Cysto-urethroscope.**—This instrument employs the Goldschmidt-Nitze type of direct non-prismatic telescope in a specially designed endoscopic tube, and is so constructed that by interchange of its parts it is available either as a cysto-urethroscope for the anterior urethra, an air-inflating or aëro-urethroscope, a posterior urethroscope or cysto-urethroscope of the irrigating type, a Kelly cystoscope, an Elsner-Braasch cystoscope, and a direct catheterizing cystoscope and operating cystoscope. It consists of

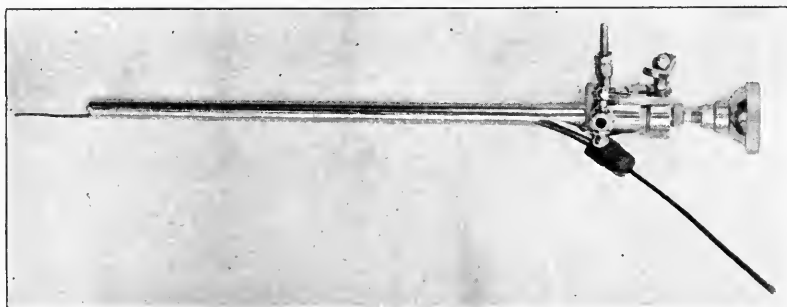


FIG. 89.—Buerger's universal urethroscope with Philip's filiform bougie for treatment of strictures of the urethra.

a straight endoscopic tube (Fig. 89), an obturator for the anterior urethra, a curved obturator for the posterior urethra and bladder, a light-carrying tube, a telescope, and a magnifying window. The endoscopic tube carries a large catheter outlet for the introduction of operating devices, applicators, catheters, etc., and permits of the introduction of either of the two obturators and also the light-carrying tube. Either the direct non-prismatic telescope or the magnifying window fit into the ocular end of the light-carrying tube.

**Technic.**—The sheath fitted with the curved obturator for the bladder and posterior urethra or the short obturator for the anterior urethra is introduced, and when the bladder and posterior urethra are to be inspected the obturator is removed, the bladder emptied and irrigated through the sheath. The light-carrying tube and telescope are then locked into place, and the irrigating fluid is allowed to flow. The trigone and ureters come into view and the ureters may be catheterized according to the direct method. The instrument is withdrawn, the trigone, the sphincteric region, the supramontane, montane, membranous, bulbous, and penile urethra are inspected, a sort of periscopic view being obtained of the neck of the bladder and urethra. This instrument will be found particularly useful in the recognition and treatment of filiform strictures of the urethra.

**Urethroscopy in the Female.**—The Kelly type of endoscope answers for work in the urethra itself. For the juxtaspincteric margin, however, the operating cysto-urethroscope is to be preferred.

**Selection of Cystoscopes, Urethroscopes, and Cysto-urethroscopes.**—In the vast majority of cases (more than 99 per cent.) the Buerger combination cystoscope with two sheaths will suffice for observation and ureteral catheterization. A No. 18 French single catheterizing and a 21 French Buerger catheterizing cystoscope are useful when small caliber is desirable. In children a small Nitze or Otis-Nitze (10 or 12 French) for observation, a single catheterizing (17 or 18 French), and Buerger's smallest 15 French single catheterizing have their sphere of application.

In special cases, such as contracted bladder, in prostatic hypertrophy for study of the sphincteric region, and when the posterior urethra, too, must be attacked, the operating cysto-urethroscope is to be used. It combines the possibility of operative work with synchronous ureteral catheterization either through its operating telescope or through a special telescope carrying a fin and two catheter outlets.

Whenever we desire to combine ureteral catheterization with any endovesical operative procedure, an operating cystoscope, or the combination operating cystoscope (p. 86) should be selected.

For inspection of the anterior urethra the straight tubes (Valentine, Squier, Luys, or Young) are admirable. For the posterior urethra the Loewenhardt, Swinburne, or Luys find adherents. The cysto-urethroscope is best in our opinion. In treating the posterior urethra the two types of Buerger operating cysto-urethroscope are recommended. For Buerger's method of treating filiform strictures of the urethra the direct non-prismatic universal cysto-urethroscope should be employed.

#### BIBLIOGRAPHY.

1. Buerger: *Am. Jour. Surg.*, April, 1913.
2. Buerger: *Am. Jour. Urol.*, January, 1911; loc. cit., January, 1912.
3. Buerger: *Ann. Surg.*, February, 1909.
4. Buerger: *Med. Rec.*, June 21, 1913.
5. Buerger: *New York Med. Jour.*, April 1, 1911; *Am. Jour. Urol.*, September, 1911.
6. Buerger: *Surg., Gyn. and Obst.*, August, 1915.
7. Frank: *Med. Klinik*, 1907, No. 12.
8. Hinman: *Jour. Am. Med. Assn.*, June 26, 1915.
9. Kelly: *Johns Hopkins Hosp. Bull.*, 1893, iv, 101; *Am. Jour. Obst.*, xxix, 1.
10. Oberländer-Kollmann: *Die chronische Gonorrhoe der männlichen Harnröhre*, Leipzig, 1910.

### CHAPTER III.

## METHODS OF DIAGNOSIS IN LESIONS OF THE URINARY TRACT.

By BRANSFORD LEWIS, M.D.

**Introduction.**—The following general remarks on genito-urinary diagnosis may be looked on by some as an innovation not sanctioned by custom, and one hardly appropriate to a scientific treatise for urologists. But when it is understood that they are written for the advancement of the scientific aspects of urology—to bring up and straighten out the irregular marching lines where they are hesitant and lagging; when it is understood that they are written from the stand-point of the earnest student of facts and causes; and that the conscientious hope exists that they may throw some light on the vital and glaring question, why so many failures in genito-urinary diagnosis continue to appear, notwithstanding that this is an era of ample instrumental equipment and well-organized technic for the successful practice of urology—it is hoped that these remarks may seem timely and appropriate. But especially is it desired that they may be received in the spirit in which they are tendered, as having the sincere purpose of being serviceable and practically beneficial to all concerned—to patient, specialist, and practitioner.

In further explanation, it might be said that the writer esteems diagnosis as the most important, by far, of all the subjects of urology; and he believes that anything that contributes to a better understanding of its general principles, its successes or its failures, should promote the interests of urology from its foundation up.

### SOME VITAL TRUTHS REGARDING GENITO-URINARY DIAGNOSIS.

Diagnosis in urology has experienced mutations and phases of evolution just as have other departments of medicine and surgery.

While in ancient times Hippocrates and Cornelius Celsus pursued logical though primitive methods in reckoning diagnoses and applying their deductions to the treatment of urinary retention, stone, and other genito-urinary affections, it remained for the later period of medievalism to witness the most extreme exploitation of the urine as an index of disease. Guiteras<sup>1</sup> relates that at this period (about the fifteenth century) examination of the urine was resorted to not only by the regular practitioner and the university graduate, but also by the school of quacks, known as uromancers or uroscopists. These

quacks would gravely inspect urine passed into glass flasks and immediately guess the illness and temperament of the patient, and then base a miraculous cure thereon. While the modern trend is hardly so materialistic as this, it is, nevertheless, a fact that there have been marked changes in that direction in methods of investigation for developing diagnoses, even during the last quarter-century. Previous to that time investigators of greatest acumen had, perforce, to resort to and rely on the evidences then attainable in genito-urinary diseases, which consisted mainly of symptomatology plus the external evidences observable and an examination of the urine. Under the stress of necessity urologists became most skilful in refined analysis of symptoms, weighing at its full value every deviation from the normal either as detected by them or as related by the patient; the art of deduction doubtless reached its ultimate degree of perfection in the hands of Ricord, of Fournier, Guyon, Sir Henry Thompson, and Ultzmann. The contributions of Guyon fairly scintillate with logic and acumen as they relate the diagnostic estimate to be placed on the symptoms of urinary tuberculosis, urinary lithiasis, "painful cystitis," etc. But the trouble came when there were no symptoms to analyze; when there were kidneys destroyed by stone and never a backache; when there was pus in urine and little to indicate its source; hematuria and no index of its causation or its point of origin. The difficulties of the situation were enhanced by reason of the fact that the genito-urinary organs, hidden more or less in the body, were inaccessible to the means of research then available; and reliance was limited to the examination of the only factor that was at hand, namely, the urinary excretion.

There can be no doubt that accurate and comprehensive diagnosis has been the most influential factor in the establishment of urology on the scientific and satisfactory plane on which it rests today. It was the turning of the patient inside out, so to speak, and the plain demonstration of the cause and nature of his complaints by means of the various instruments of diagnostic precision, that has accomplished the miracle of evident progress; that has developed urology from venereology; that has won this field from the domain of obscurity and empiricism to one of science and accomplishment.

Nevertheless, while urology as a specialty has progressed in the manner and extent mentioned, it cannot be said that the general profession has kept pace with its progress. The chief basis for this remark lies in the countless number of genito-urinary patients who suffer needlessly from month to month and year to year—ten, twenty or more years, often—while under the care of practitioners who go no further in efforts at relief than to supply various "favorite prescriptions" for urinary symptoms or complaints. Instead of giving undivided attention to efforts at learning the source and causation of a hematuria, they supply drugs and measures for stopping the bleeding, which is the worst object that could be accomplished by them at that time. Instead of learning the origin and nature of an infection, they are industriously and empirically supplying "internal antiseptics," vaccines, or urinary

soothing syrups, that palliate, perhaps, but incidentally postpone the day of definite diagnosis and effectual relief. The patient may, indeed, have cause for self-gratulation if he is not incidentally conducted, meantime, from a benign into a malignant period of growth in the bladder, passing from a condition amenable to treatment into one beyond relief or hope. When he is finally referred for the examination that has been long deferred or ignored, he is found to be beyond all human aid save that of palliating his progress to the grave. The failure of relief in an infinite number of such cases is due, not to obscurity of the disease or difficulty in diagnosis, but to the fact that no effort to attain a real diagnosis is systematically or methodically made or even advised. The precious time is spent on so-called treatment, and a wonderful opportunity is wasted. If members of the profession could collectively realize the truth and import of these facts they could better appreciate the incalculable importance of genito-urinary diagnosis as compared with immature and ill-based therapy, and would oftener refrain from the reversed action alluded to.

It is believed that so great is the importance of this matter that an awakening and reformation of the profession in this respect would not only redound to its benefit in scientific progress, but would markedly subtract from the sum total of human misery as well as add materially to the span of human life.

There is one thought in this connection that cannot be suppressed or overlooked: Whenever a practitioner of medicine, either general or special, undertakes the care of a patient, he assumes responsibilities that he cannot avoid; he takes on the moral obligation to supply or to have supplied to that patient all means and mechanisms at the disposal of the profession that are necessary for securing the relief desired, and this whether the practitioner is himself capable of using them or not. Lack of familiarity with the use of the x-ray machine, or failure to possess one, does not excuse him for depriving his patient of the advantages of such a machine when needed. The same reasoning applies to the ophthalmoscope, or the cystoscope or any other of the paraphernalia so useful and often so essential in modern medicine and surgery.

Another broad fact of importance in this connection is that no practitioner who undertakes the care of such cases has the right to disclaim knowledge of the appliances used in the various specialties, and on that account justify himself for emitting the false doctrine that "nothing else can be done" in a given case. No one, in the author's humble opinion, has the right to make any such ex-cathedra statement, and many a poor patient has, doubtless, been assisted to his grave on account of it. A better, truer, and more serviceable axiom would be: *Something can always be done.* And, it might be further remarked, mainly through diagnosis.

As to the causes of backwardness and inadequacy in genito-urinary diagnosis, it is probable that a part of the difficulty lies in the fact that the methods and technic of genito-urinary examinations, being of

comparatively recent development, are not yet familiar to the profession at large, or that they assume formidable proportions in the perspective of infrequent use or lack of practical experience.

As a matter of fact, for most genito-urinary diseases the demands of serviceable diagnosis are easily met and may be carried out by anyone who possesses a logical mind and a reasonable acquaintance with laboratory technic. This remark, of course, does not apply to the more refined and difficult steps of investigation, such as those of endoscopy, cystoscopy, etc. But for the ordinary investigation the greatest lapse seems to be in the lack of a formulated plan for pursuing the examination.

**Relative Value of Symptoms and of Physical Examination for Diagnosis.**—There should be no denial of the value of a well-rounded and carefully studied history of a genito-urinary case. Symptoms are often typical and characteristic of certain maladies, and lead to ready deductions that prove correct on applying the steps of investigation without which no genito-urinary diagnosis should ever receive consideration. But in many instances urinary symptoms are not typical, are not regular, do not conform to what would be expected of them or harmonize with the actual pathological conditions as later demonstrated by postmortem examination or otherwise. In many such cases the symptoms are unconventional and misleading. In renal cases, for instance, pain may arise apparently from the healthier of two diseased kidneys; or, indeed, acute and severe pain may be thus transposed from a totally diseased to a healthy kidney of the opposite side. If symptoms were to be accredited in such cases without the test of searching physical examination, it would readily lead to disastrous consequences. In fact, it has led to disastrous consequences in actual experience. These are facts well-known to all practitioners of experience in urology.

**Method in the Quest for Diagnosis.**—A certain prescribed plan of investigation should be carried out in every case of chronic urinary disorder, and all the steps should be included up to the point at which the diagnosis is not only made but *completed*.

In a given case of urethritis, for instance, it is necessary to learn, not only the nature of the infection—as to whether gonococcal or not—but also whether the posterior urethra is involved, and the prostate, and seminal vesicles, and all other parts of the body subject to such microbic invasion. The omission of either one of these features of diagnosis would be as serious an oversight as the omission of the other. To find gonococci in a urethral discharge and then treat the anterior urethra only, failing to recognize and treat the infected posterior urethra as well, would be like putting a splint on one of two broken legs and neglecting the other. That very tendency of many to ignore the post-urethral infection has probably been the most prolific source of failure in the treatment of gonorrheas, as was pointed out by the author as early as 1893;<sup>2</sup> and, similarly, with the diagnosis of prostatic obstruction, certain factors are absolutely essential to a serviceable diagnosis

and nothing short of them all will suffice. They must include definite information as to whether:

1. The prostate is hypertrophied or atrophied?
2. Whether there is obstruction to urination?
3. If so, the relative amount of obstruction?
4. The form, physical characteristics and nature of the obstruction?
5. The physical condition and functional activity of the allied organs (especially heart and kidneys).

To illustrate why it is necessary to learn all of these individual features in prostatic obstruction, it may be mentioned that no one could determine the proper measures for relieving such a case without first learning the several points of diagnosis mentioned and then acting on that precise information. And if, for instance, he learned the correct answers to the first four of these diagnostic points, operated skilfully but ignored investigation of the fifth point (with reference to the condition and functional activity of the allied organs), it might very readily prove to be another case of "successful operation, but the patient died;" because renal involvement with unrecognized suppression of urine, uremia and death may follow on the heels of the "successful" operation, a result that should readily be avoided by attention in diagnosis to the point under discussion, together with appropriate preparatory treatment. Hence it is evident that diagnosis, to be efficient, must be not only analytical but comprehensive and inclusive.

But to show that in the given instance of prostatic obstruction it is within the ability of any practitioner of ordinary skill to acquire the information desired in the five diagnostic points, it may be mentioned that the first point is determined by rectal palpation, the finger detecting whether the prostate is unduly large, unduly small, or of approximately normal size. The second point is determined by the passing of a soft-rubber catheter into the bladder directly after the patient has finished voluntary urination, which shows whether there is residual urine or not; and the quantity of residuum thus obtained is the answer to the third point. The fourth point is not so easily settled, but, nevertheless, should be settled in every case that has been proved by the steps above mentioned to be the subject of prostatic obstruction. It is most advantageously accomplished by means of the cystoscope, and especially the retrospective lens of the cystoscope, showing the conformation and character, etc., of the vesical neck and prostate. The fifth point is determined by examination of the urine and physical examination of the heart, together with the application of such functional tests as are appropriate.

It is therefore apparent that if carried out methodically and judiciously, the essential requirements for a working diagnosis of such a case, with the exception of one point only (cystoscopy), are within the ability of every practitioner of even ordinary skill and experience; and nothing has been demanded in the technic that was either unreasonable or ultra-scientific. As to the cystoscopy, every town of self-respecting ambition now possesses a cystoscopist of sufficient ability to resolve that question.

Hence the difficulties have proved, when fairly attacked, neither insurmountable nor appalling. Which may be said to be true, also, of diagnostic endeavors with reference to other diseases of the urinary organs. Difficulties melt down and disappear in the face of method and system, and repeated endeavor brings success.

### PLAN OF INVESTIGATION.

So much depends on method and system in developing genito-urinary diagnosis that some definite plan should always be followed. The field of investigation being more or less limited, it is feasible, therefore, for those following this work as a specialty to formulate and have printed in the history book a series of questions relating to the several genito-urinary organs or diseases, with a blank for the response, which may be filled by an affirmative or negative sign for reply. This markedly shortens the time and labor in getting and recording the history. Current and additional events, treatments, reactions, and responses may be recorded on cards that are indexed and filed after the usual card-index filing system. Intricate and time-consuming bookkeeping may be avoided in this manner and all necessary records continued and kept indefinitely—and always available.

The diagnosis should be based on the following three kinds of evidence:

1. History and symptoms of the case.
2. Physical examination of the patient.
3. Examination of the secretions and excretions, pathological and physiological, of the organs in question; and of the blood (complement-fixation tests).

**I. History of the Case.**—The questioning should cover the family history, the previous personal history, and the history of the existing complaint. In the family history information that would have a bearing on hereditary influences and stigmata should be learned. The baleful effect of inherited syphilis is discovered with surprising frequency when definite search is made for it. This is especially true now that the Wassermann blood-test has come into frequent use. The writer has found syphilis to be the underlying factor in a number of instances in which there had been obstruction at the vesical neck from childhood to manhood.<sup>3</sup>

While a positive history of hereditary syphilis might be of great significance, one should not place too much reliance on a failure to acknowledge such a history if there is reason to suspect the contrary. It is like the Wassermann blood test in this respect; while the positive test is of great import, the negative is of relatively little significance and must not weigh heavily in the final estimate. Neurologic, neurotic, and other tendencies should be inquired into as related to family traits.

**Previous Personal History.**—In both chronic and acute affections of the urinary tract antecedent infections frequently have a dominant influence, and failure to discover them in developing the history may

seriously handicap one's understanding of the case. Chronic and recurrent urethral discharges often are only exacerbations of uncured but apparently inactive urethritis; subacute vesiculitis may persist for years after active urethral discharge has ceased to be an outward sign of trouble. The insidious evidences of urethral stricture come on when the patient has but a dim remembrance of his former infection. Even at the risk of a seeming insistence the questioner should tactfully learn about all such "accidents" and conditions of the patient's former life.

Habits and customs have a bearing that is unrealized by individuals, sometimes; such as habitual postponement of the act of urination until long after the desire has been felt, either from occupational causes or undue modesty. Permanent damage to the bladder, ureters, and kidneys is occasionally the price of such heedless practices.

Habits of eating and drinking may have a bearing on obscure cases.

Evidences of rheumatism, tuberculosis, defective metabolism, dyscrasias, loss of weight or strength, should be developed in the history.

Focal points of irritation and infection at distant parts of the body are now recognized as having a preëminent bearing on the urinary tract, notably the kidneys in connection with nephritis.

Special inquiry should be made about pain; frequency or urgency in urination; changes in the urine; changes in the stream.

Undoubtedly pain, though irksome, is a great conservator of the human kind. It is unfortunate that a larger proportion of genito-urinary maladies are not ushered in with pain. A larger proportion of sufferers would thereby be impelled earlier to seek medical assistance. Many accept even a bloody urine complacently for a long time just because there is no pain accompanying this portentous sign. A patient who possessed a growing hypernephroma held a letter of introduction from a physician to the writer for over six years before finally presenting it; there was pronounced hematuria all of that time.

Pain may be primary or secondary in the genito-urinary organs. Originating in a diseased or strictured urethra, the irritation may be reflected into the rectum, presenting the whole complaint, so far as the patient knows it, at that point. Or *ascarides vermicularis* may display their vicious effect by reflected irritation from the rectum into the urethra, producing inordinate frequency or troublesome difficulty in urination. Therefore, although one must learn what he can about pain, in getting the history, he must refrain from making deductions concerning it until physical examination is able to set him right.

Pain in the back is ordinarily ascribed by the laity to "kidney disease," and on so slight a piece of evidence do they often take cures and courses of treatment at the spas of repute. The profession is well aware that pain in the back seldom has such a significance, but the profession is not so well aware of the fact that an actual renal pain is often transposed from one kidney into the region of its fellow; and it often requires the more exact findings of physical examination to establish the real origin of the complaint.

The pain of prostatic inflammation is frequently reflected into the glans penis; that of the ureter into the cord and testis; that of the vesicles into the back, the rectum, or the testis.

Frequency and urgency in urination are standard indications of *irritation of the posterior urethra*, not of the bladder. Inflammation of the posterior urethra is in itself a source of irritation and arouses the undue desire to urinate; hence undue frequency results. A healthy person should urinate from three to four times in twenty-four hours, and should not have to get up in the night for that purpose. It is practicable, therefore, to draw a fairly distinct line between normal and abnormal frequency of urination.

Undue frequency in the daytime usually means an irritative or inflammatory causation, such as posturethritis or vesical stone; whereas, nocturnal frequency is more likely to indicate an obstructive causation (prostatic obstruction).

**Changes in the Urine.**—The changes in the urine most liable to impress themselves on the attention of the patient relate to the appearance of blood, of pus, or of precipitated urates or phosphates. Information based on the time of appearance of any of these may be of great importance, as showing whether an infection or disease is of recent or remote origin. Patients have been able to establish that the clouding of their urine, for instance in an obstructive condition in an adult, had existed since childhood, which would at once eliminate ordinary prostatic hypertrophy or gonorrheal infection as the originators of the trouble and give the investigator quite a different view-point from the one that might be forming. The most effective use that can be made of information that the urine is bloody is immediately to start the train of real diagnostic endeavor—to put into motion the arrangements for systematic examination of the whole urinary tract and not only trace the blood to its origin, but also to learn the reason for its appearance in the urine. *Until both of those objects are accomplished no effort should be made to stop the bleeding*, unless it is of menacing proportions. In the presence, then, of hematuria, the first duty of the practitioner is one of diagnosis, not of treatment.

**Changes in the Urinary Stream.**—Much significance has been attached by some to the description of changes in the stream as given by patients, but in view of the lack of information or observation powers in many patients, and their proneness to see the same things differently, the writer has seldom found their impressions in this regard to be of much service. Some patients with a normal stream complain that it has been twisted latterly; and others with well-defined obstruction from stricture or congenitally narrow meatus, say that they have never had any impediment in urination. It is hardly justifiable to place reliance in such an insecure basis. If, however, the investigator himself has the opportunity to observe the stream, its description may be worth while in the record.

**II. Physical Examination.**—Nowhere in medicine or surgery do method and system count for more than they do in pursuing the

physical examination of genito-urinary cases. Many times this will save the investigator from overlooking conditions that have a vital bearing; conditions that, without method and system, would assuredly go undiscovered. On a number of occasions the writer has seen crystal-clear urine passed by patients which might have led to the inference that there could be no such thing as gonorrheal infection present; yet massage of the vesicles made directly afterward has brought out pus and gonococci, leading to a vastly different conclusion and furnishing the required revelation for diagnosis and proper treatment.

**Physical Examination.**—Following the taking of the history the urologic patient should be conducted through certain prescribed steps of physical examination, and without regard to whether diagnoses have been made of his case before or not. The only exception to this rule should be that in which the infectiousness or acuteness of the trouble indicate a postponement of instrumentation until a period in which it will not in itself cause injury or extension of infection.

Physical examination in genito-urinary cases may be divided into general and local. The local examination naturally takes precedence over the general from the nature of the conditions.

The steps of local examination may be subdivided into (a) those preceding instrumentation, and (b) those including instrumentation.

**Local Examination.**—(a) *Steps Preceding Instrumentation.*—1. *Inspection.*—Obtain good exposure of the external genitals for complete inspection: Coat and vest off and clothing widely open. Inspect the external genitals, including especially the prepuce and urethral meatus for pathological secretions. If present, make smears on three glass slides for microscopic investigation: one for methylene-blue stain, one for Gram stain, and a third for reserve.

2. Have the patient urinate into two clean, clear glasses, for inspection and chemical and microscopic examination:\*

**Microscopic and Chemical Examination.**—1. Centrifugalize the two glasses of urine for microscopic and chemical examination. The first portion is better for detecting infecting organisms, pus that is sparse, red blood cells, etc.; while the second part is preferable for chemical examination and study of the condition of the kidneys, as indicated by the urine: Albumin, casts, red blood cells, urates, phosphates, specific gravity, etc.

2. *Palpation.*—Prostatic and vesicular palpation and massage. While the urine is undergoing sedimentation step No. 2 may be carried out. With the patient well exposed, bending forward over a chair, the hand of the operator protected with a finger cot or rubber glove, lubricated preferably with one of the iceland moss or gum tragacanth

\* If from the interview a suspicion of urinary tuberculosis is aroused, a specimen should be taken, by catheter only, at a subsequent time or at least after completion of the several steps now being described. Urine passed voluntarily should never be used for tubercle bacillus investigation (except for guinea-pig inoculation) because of the likelihood of confusion with the smegma bacillus. The only safe method is to exclude the smegma organisms by aseptic catheterization, either in males or females.

preparations, palpation of prostate and seminal vesicles is carefully executed; after which gentle massage of these organs is also carried out. At the same time a sterile butter platter or saucer is held under the penis and catches the drops of secretion expelled by the massage. This also furnishes material of value for microscopic examination, both in the stained and unstained ("fresh") condition. Gonococci that were undiscoverable in the urinary specimens may be plainly evident in the massage specimens, and if such proves to be the case, one can readily understand why it is worth while to be persistent and searching in such examinations.

There may have been no discharge at the meatus, in a given case; there may be nothing of importance (pus, organisms) found in the sedimented urine passed after the inspection, and there may be no dripping into the butter platter on massage; and yet means are still available for gathering, at this time, gonococci-laden secretion from prostate or vesicles. With this object in view, following the massage and before any instrumentation is undertaken, the patient is directed to pass water again, this time into a third glass; and even though he urinated only a short while previously and he now passes but a few drops of urine, that amount suffices; for it brings out with it the massage effect (pus, mucus, leukocytes, organisms, spermatozoa, etc.) that up to that time had been retained in the posterior urethra by mere lack of sufficient volume to flow out. It has now been washed out by the additional drops of urine, and is at our disposal for examination just as if it had been obtained in the more usual way. If the patient proves unable to pass the additional urine into the third glass, we have still another mode of obtaining the desired massage effect: without a catheter, inject two or three ounces of warm distilled water into the bladder and allow the patient to pass it into the third glass. It is then sedimented and examined as previously described.

**Microscopic Examination.**—See Examination of the Urine.

**Instrumentation.**—(a) Of the urethra; (b) of the bladder; (c) of the ureters and kidney pelves.

**INSTRUMENTAL EXAMINATION OF THE URETHRA.**—This step is for chronic cases, not for acute. It should be conducted without pain or disturbance to the patient, leaving with him not even an unpleasant memory; and yet sad experiences with instrumentations may keep patients away from needed medical service for years at a time, so painful and shocking sometimes are they.

**Local Anesthesia.**—Fifteen to twenty minims of 5 per cent. alypin solution properly used at this time are worth their weight in gold—giving contentment to the patient and blessings to the doctor. A rubber-tipped anterior urethral syringe is used to inject the solution into the urethra, a cushion of air following the fluid serving to distend the urethra and diffuse the solution as far as desired. The cushion is made by injecting the air with the same syringe (Fig. 89). The early burning effect is soon replaced by effective local anesthesia, whereupon bulb sounds (the largest possible size first, smaller ones next) are passed

as far as the cut-off muscle, to learn if there are strictures in the anterior urethra; or an air-inflation urethroscope of Mark is used for the same

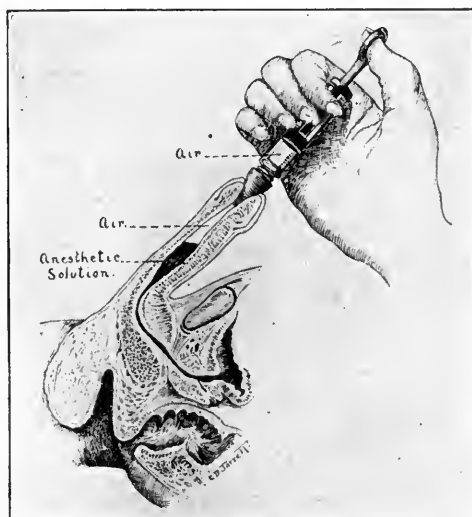


FIG. 89.—Anesthetizing the anterior urethra.

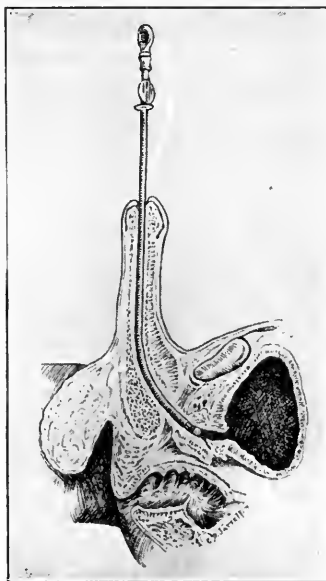


FIG. 90.—Anesthetizing the posterior urethra: Depositor dropping alypin tablets in prostatic urethra.

purpose, disclosing at the same time any erosions, granulations, cicatricial deposits, etc., of chronic urethral processes. A full-sized urethral

steel sound may be used for determining the permeability of the posterior urethra; or it may be replaced by use of the posterior endoscope of McCarthy or Buerger, which give a distinct view of the verumontanum and its varying pathological conditions. Lastly, the steps of ordinary instrumentation are completed, in cases in which urinary obstruction or retention is suspected, by the passage into the bladder of a soft-rubber catheter for determining the amount, if any, of residual urine left after the voluntary urination of a few minutes before.

(NOTE.—A dram or two of urine thus found would be negligible; whereas, forty ounces would mean severe obstruction, and the several points for diagnosis previously mentioned (page 111) would then have to be solved.)

*Tubercle Bacilli.*—If there is reason to suspect urinary tuberculosis, this is the stage at which investigation with this in view should be pursued.

In certain cases the bacilli of tuberculosis are numerous and easily found in the urine; in other cases they are scarce and are then demonstrated microscopically only with difficulty. An expedient that serves for their easier detection, to which attention was called by Bryson, is that of utilizing for examination the small amount of urine (a dram or two) that may be drawn by catheter shortly after the patient has urinated voluntarily. It is supposed that this serves to collect the bacilli which have settled in the bas-fond, remaining and accumulating there in spite of successive urinations.

The custom of catheterizing after voluntary urination may, then, have a double object: The determination of residuum, and the detection of tubercle bacilli. The importance of this is reinforced by reason of the belief, long held by the writer, that voluntarily passed urine should never be used for searching for tubercle bacilli. The chance of finding the acid-fast smegma bacilli in such urine is too great and of differentiating them from tubercle bacilli too precarious to place reliance on such a measure. The only means that affords reliability, both in men and women, is to draw the urine by aseptic catheterization, avoiding the possibility of including smegma bacilli in the specimen.

The writer has personal knowledge of several instances in which failure to carry out such precautions led to erroneous diagnoses and disastrous consequences, reliance having been placed on the accuracy of the bacteriologists' unsupported reports.

*Summary.*—The steps thus presented may seem from description elaborate and ponderous; but they are much more so in description than in practice, and take much longer in the telling than in the execution. One might readily elaborate a more complicated plan of investigation, but the writer believes the one submitted to be simple, definite, and practicable; and no one who endeavors to do good work in this department can afford to minimize or ignore them. Nor should the sequence of the steps be reversed. The passing of any instrument before the voluntary urination or the massage would, from traumatism, superinduce the presence of blood and other cellular elements in the

urine that might wholly change and disguise the actual conditions prevailing and lead to erroneous conclusions.

**INSTRUMENTATION OF THE BLADDER.**—Sounds; stone-searchers. From time immemorial reliance has been placed on sounds, bougies, and stone-searchers for detecting foreign bodies, tumors and other pathological entities within the bladder. The sharp contact of a metal sound or searcher with a stone in the bladder elicits a click that is distinctive and of definite value for diagnosis *when attained*. But in a large proportion of cases in which vesical stone is present the click is not obtained. The stone may be coated with soft, sticky mucus that softens or prevents the expected contact; or it may be ensconced in a pocket under an overhanging prostate (Fig. 91), or in a diverticulum, preventing the approach of the searcher within striking distance of the stone.

Positive evidence only is of value with this method. But many a surgeon and patient, relying on its negative evidence, have been soothed into false security against the presence of stone and have failed utterly

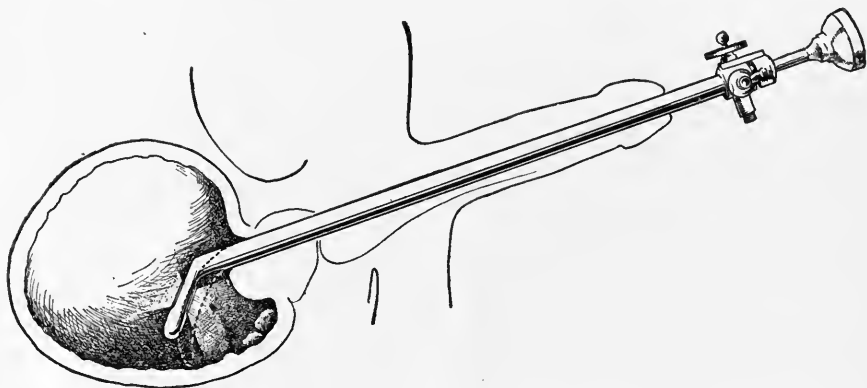


FIG. 91.—Enlarged prostate rendering stones inaccessible to sound, but evident to retrospective universal cystoscope.

in their efforts at diagnosis. A diagnostic appliance or method to be efficient must be reliable; one that gives a large proportion of failures is not reliable and should be replaced by others affording reliability.

**Cystoscopy.**—Cystoscopy outweighs all other methods and measures for diagnosis of affections of the bladder and upper urinary tract. It is analytical, comprehensive, and convincing.

A discussion of cystoscopes and cystoscopic methods is presented elsewhere, but it is deemed appropriate to consider the logic and propriety of cystoscopy here.

**Indications for Cystoscopy.**—The indications for cystoscopy in connection with disturbances of the upper urinary tract are many; the contra-indications are few.

Cystoscopy should be performed in practically all cases of chronic urinary disturbance in which no definite contra-indication is present.

It is often the case that an existing seminal vesiculitis or prostatitis appears quite sufficient to account for the persistence of an infection,

and treatment is expended solely on them without result, until finally, discouraged by lack of success and merely as an experimental measure, cystoscopy and ureteral catheterization are carried out, whereupon a flood of light is unexpectedly thrown on the case. It is found that the infection involves one or both pelves of the kidney as well, and that explanation might never have been attained without the cystoscopy and catheterization.

Hematuria, pyuria, microbic infection, when demonstrable as coming from the upper or middle urinary tract, symptomatology that is inveterate or is apparently referable to the kidneys or ureters, no matter of what character, demand cystoscopy with insistence that should never be denied. The definite indication in many of these is for diagnosis first, not treatment; and cystoscopy, together with ureteral catheterization and radiography, are the means above all others for meeting that indication. Therefore, with chronic or obscure or unsatisfactory conditions of the urinary tract, it is advisable not to be too punctilious in awaiting the positive indications for cystoscopy, but rather to withhold it only in the face of definite contra-indications opposing it.

*Contra-indications to Cystoscopy.*—Acute inflammatory conditions of the urinary tract, together with exacerbations of chronic inflammations, form contra-indications for cystoscopy. This does not apply to anuria from renal or ureteral stone, which sometimes is relieved by ureteral catheterization. The same measure has been known to start up urinary secretion, for a time at least, in anuria from nephritis; so that cystoscopy need not be feared in these conditions where there is reason to apply it.

Urinary tuberculosis has by some been considered a dangerous field for cystoscopy. It would more properly be termed a dangerous field *without cystoscopy*. The outcome of neglected urinary tuberculosis is not only unpromising but almost assuredly fatal. Urinary tuberculosis in the earlier periods means *infection of one kidney only* so far as the urinary tract is concerned. In other words, the discovery of the nature and location of the infection—clearly the province of the cystoscope—is the vital, pivotal step to be taken at a time when such a discovery is of service—at a time when it may lead directly to removal of the originating focus of infection from the body and reclamation to health of the patient. No means other than the cystoscope can compare with it in the performing of this function.

On the other hand, experience with thousands of cases of urinary tuberculosis, in the hands of many operators, has failed to show that cystoscopy is injurious. Such patients are usually inordinately tender and demand the liberal use of local anesthetics, but they recover from the transient effects of instrumentation quite satisfactorily. Some obstructive phases of urinary tuberculosis are even improved by instrumentation and local medication.

*Prostatism.*—It is well known that prostatics may go for long periods with considerable obstruction and no infection until some form of instrumentation is undertaken; and whether this be done with or with-

out careful aseptic precautions it is liable to precipitate the long-deferred urinary infection and bring about conditions more painful and irritative than any that previously existed. Yet the claim that a prostatic should never be instrumented because of these facts would hardly receive general support. Like catheterization, cystoscopy is one of the disagreeable necessities, temporarily objectionable, perhaps, but having the ultimate object of permanent relief and restoration.

As mentioned previously, prostatic obstruction is of such multifarious production that it cannot be adequately coped with except on a basis of accurate diagnosis.

Contracture, hypertrophy, cyst formation, all may produce obstruction, but do so in different ways; and it requires cystoscopic inspection to differentiate between them.

It is as illogical to expect to accomplish this object without cystoscopy as it would be to expect to determine the amount of obstruction present without using a catheter. And the use of either is as liable to be followed by infection as the other. But their use paves the way to recovery and is therefore amply justified.

Urethral stricture, prostatic inflammation, or abscess and other obstructive conditions militate against or interfere with the use of the cystoscope; but under such circumstances they themselves are the conditions demanding attention, and there is seldom any need for cystoscopy in connection with them. But if such a need were found, the obstructing factors could be attended to first, opening the channel for the introduction of the cystoscope. A narrow meatus should be incised for the same purpose when necessary. It must be remembered, too, that there are small-calibered cystoscopes on the market (No. 17 or 18, French) which, though sacrificing certain features of the larger instruments, are advantageous for such exceptional conditions.

*Urine Segregation.*—The separation of the urines of the two kidneys by means of segregators for a time was held in favor by some, but further experience with such instruments has proved that they are quite unreliable for diagnostic service in that they give false returns and lead to erroneous conclusions. In working with them the operator is working in the dark and must take for granted that such exacting conditions are fulfilled as that of obtaining an effective watershed between the ureteral orifices, and that each tube of the instrument is draining from its respective side and from this side *only*. That the instrument is unreliable was proved by Kümmel,<sup>2</sup> who found that in a case in which he had previously removed one kidney, the only urine that flowed came from the side on which the nephrectomy had been done.

Aside from its incompetence for diagnosis, the segregator suffers when compared from the therapeutic stand-point with cystoscopy and ureteral catheterization. It offers no possibility of sounding ureters or of administering irrigations to kidney pelvises.

*URETERAL CATHETERIZATION.*—Ureteral catheterization is so closely associated with cystoscopy that what has been said may well refer, for

the most part, to this procedure also. But when, by cystoscopy, the pathological condition is clearly demonstrated to be in the bladder, such as a tumor, stone, simple ulcer, etc., and there are no indications of further trouble above, ureteral catheterization may be deemed unnecessary.

Some authors place much reliance on meatoscopy as a guide to conditions in the upper tract. They watch the urine as it issues in jets from the ureteral orifices, and inspect the orifices themselves, alleging that reliable evidence may thus be obtained as to the presence of pus or blood in the respective urines or pathological conditions in the ureters. It is but another instance of positive evidence being valuable and negative evidence worthless, or worse.

If the ureteral orifice displays ulceration or the funnel-shaped depression characterizing tuberculous ureteral contraction, the evidence is of value; but it is established that many kidneys are tuberculous without the corresponding ureteral orifice showing any deviation from the normal. And to await the ureteral demonstration would be indefinitely postponing required action and seriously endangering the chances of the patient.

As to the other claim, if it is impossible to say whether there are pus or blood cells in a glass of fairly clear urine without examining by the microscope, one can readily appreciate how much greater the difficulty of making the determination by macroscopic observation of urine while it is being ejected from ureteral orifices. The claim is preposterous except for pathological conditions that are very pronounced. There would be no objection to the claim did it not incline to mislead inexperienced cystoscopists who may not realize the fallacies of the situation.

It is advisable, therefore, not to forego the many advantages of ureteral catheterization on too slight provocation. Many pathological conditions of the ureter are not discoverable by meatoscopy. Ureteral strictures, kinks or dilatations may betray no evidence at the meatus of their existence.

*Wax-tip Bougies.*—The wax-tip bougies of Kelly have been tested by wide usage in the profession but have not found favor to the extent that exists with their illustrious author. That is probably explainable by the difference in the form of cystoscopes used. Kelly has never given up the use of his very simple pattern of cystoscopic specula, which he uses with women in the knee-chest position. This permits the use of the wax-tip bougies with more or less freedom from danger of contact with the instruments, thereby producing a false scratch. Most practitioners now use one of the several forms of lens cystoscopes on the market. With these it is difficult or impossible to prevent the scratching of the tip by the cystoscope itself, and thus casting doubt and confusion on the findings.

*Obstructions in Ureteral Catheterization.*—Obstruction to the passage of a ureteral catheter may occur either in a healthy or a diseased ureter. The axis of the channel may be such that the catheter impinges against

the wall and hangs there until dislodged by a twist or movement that enables the catheter to follow the curve of the channel, when it may pass easily. In other instances the presence of the catheter excites spasmodic contractions for a time of the muscles of the ureter, which clamping down on the catheter effectually oppose its passage until the spasm is relieved, when the catheter passes promptly and without further difficulty. Obstructed ureteral catheterization, therefore, does not always point to a pathological condition.

Organic pathological conditions, such as narrow ureteral meatus or stricture of the ureter, impacted calculus, kink, or an anomalous vessel crossing the ureter, may obstruct the passage of a ureteral catheter, and when met with must be differentiated by the various methods discussed. Through the influence of a strictured ureter it often happens that from the resulting or coincident pelvic infection mucopus plugs cause colics, persisting pain, and backward pressure by coming in contact with and plugging up the narrowed orifice of such a constriction. The author has seen prolonged invalidism result therefrom, relieved promptly and permanently by widening the contraction to physiological proportions.

*Lack of Drainage after Ureteral Catheterization.*—It occasionally happens that after an especially irksome and difficult essay at catheterization success is finally attained and the fruits of victory are naturally expected, but none appear. In other words, the urine does not flow through the catheters, notwithstanding their introduction well up to the kidney pelves. Such a disappointing failure may result from any one of several causes. The catheter itself may be stopped up, or it may be too high in the pelvis, thus failing to locate the eye of the catheter where it can draw the contents by siphonage or otherwise. A little mucopus plug caught in the eye of the catheter may close the outlet and defeat drainage for the time being. Another prolific cause for lack of drainage is the temporary discontinuance of renal activity in the presence of catheters in the ureters, one or both. The resulting "shock" to the kidneys seems to superinduce a temporary anuria or oliguria. The drinking of a glass of water usually restores activity and the expected drainage.

## **RADIOGRAPHY. ITS POSITION IN GENITO-URINARY DIAGNOSIS.**

**Value of Radiography.**—In connection with cystoscopy and ureteral catheterization, radiography is invaluable for genito-urinary diagnosis. It has helped tremendously to bring urinary diagnosis to its present satisfactory state. But it must not be considered as all-sufficient or free from liability to err. It indulges in errors both of commission and of omission. Its shadows must be attested and controlled lest they betray us into diagnosing stones that are not present, and its occasional failure to delineate a shadow where one ought to be is one of its lamentable shortcomings.

Nevertheless, when these failings are met and controlled by appropriate action, radiography becomes the wheel-horse of service mentioned.

The corollary to the above is that radiography in urology should not be relied on without the control of cystoscopy and possibly ureteral catheterization. It may also be admitted that for diagnosis of stone in the upper tract, cystoscopy and ureteral catheterization should not be relied on without the control of radiography. In other words, they are mutually interdependent and should be utilized together. It is mere waste of time to speculate on which is the more important of the two.

**Radiography in Diseases of the Middle Urinary Tract.**—For diseases of this part of the tract, radiography is less important, though not without marked value in certain conditions. It serves well in the detection of stone in the prostate. With oxygen gas distending the bladder Kelly has taken good negatives, showing the size and conformation of enlarged prostates. Used with collargol distention of the bladder, radiography delineates diverticula of that organ, and shows the shape and size of the bladder to advantage.

The size of a vesical tumor is often made appreciable by the same means, but without the use of the collargol. Kelly used bismuth suspension in tragacanth, and later, a suspension of argentide, for this purpose. Information regarding the size, number, and location of vesical stones and foreign bodies is afforded.

**Radiography in Diseases of the Upper Urinary Tract.**—It is especially in this part of the tract that the supreme advantages of radiography are made manifest. It is found to be most serviceable and reliable when used in connection with such control appliances as radiograph catheters (opaque to  $x$ -rays), ureteral sounds, or the injection of colloidal silver solutions (ureteropyelography). While certain precautions are required to avoid accident or injury to the kidneys in this work, it may be said that these are easily carried out, and, with them in effect, the procedures are safe.

**Dangers of Pyelography.**—There are certain elements of danger in injecting the renal pelves with collargol solution in that it has been shown that even under very moderate pressure the solution passes up the urinary tubules and permeates the kidney tissues to make infarcts and infiltrations that have proved highly injurious or even fatal.

In applying this method stringent precautions must be taken to obviate this fault. It should not be applied in a case in which drainage from the pelvis is seriously interfered with unless provision is made for prompt artificial evacuation (drainage by ureteral catheter, for instance). The injection should be made, not with a piston-syringe, which may prove too forcible in its effect, but by a simple hydrostatic apparatus such as that of Thomas.

The necessity for using radiograph catheters is brought about by the fact that calcified glands or phleboliths in the abdomen or pelvis often give shadows to  $x$ -rays that resemble those of ureteral stones, and it is

desirable to provide some method of differentiating between them. The opaque catheter in the ureter shows the exact line of the ureter, a shadow widely separated from that line is at once recognized as having no relation to the ureter or ureteral stone. A shadow in the line of the catheter shadow is differentiated by filling the ureter with collargol solution and then making the exposure (Braasch). If it is a ureteral stone shadow, a distinct difference in the caliber of the ureter above and below the shadow is seen; the ureter is relatively *dilated above the site of the stone*. Whereas, if it is only a phlebolith shadow, there is no difference in ureteral caliber above and below the shadow, as indicated by the pyelogram. Another means of differentiation is that of stereoscopic radiogram, also with the opaque bougie in the ureter (Kelly). The stereoscopic view removes the shadow from the plane of the ureter, either forward or backward, showing it is not in the ureter. It is safe not to put too much faith in the ability of the radiologist to make the differentiation by the characteristics of the shadow itself. This has proved fallacious in many instances. Nevertheless, certain characteristic differences in shadows have been noted, as pointed out by Fenwick. Shadows that are clean cut, round and grouped near the outer or ischial portion of the open pelvic space in an x-ray picture are likely to be those of phleboliths, while the ureteral stone shadows are inclined to be oval, with the long axis in the line of the ureter, and located near the median line of the body.

**Capacity of the Kidney Pelvis.**—The question is important for differentiation between a normal pelvis, a dilated one, and hydronephrosis or pyonephrosis. Injecting fluid through a ureteral catheter to the point of exciting pain, Kelly allows 8 c.c. capacity as the normal maximum; whereas Braasch considers 15 c.c. as compatible with physiological capacity.

**Indications for Radiography of the Upper Urinary Tract.**—Radiography and pyelography are applicable to cases in which there is ground for suspecting stone, stricture, kink, obstruction of any sort, or dilatation at any point in the ureter; or duplicated ureter; hydronephrosis or pyonephrosis; calculus, benign or malignant tumor, tuberculosis or abscess formation in connection with the kidney. Modern radiograms made with "soft" tubes are capable of showing shadows of abscess pockets, tuberculous and like conditions, that are of much service when correctly interpreted.

**Interpretation of Radiograms.**—It must not be thought that this is an easy matter or one requiring only indifferent ability. Much experience and refined judgment are really necessary; and these must be backed with the repeated testings and the various methods of control available.

**Preparation of the Patient.**—In anticipation of radiography the patient should be prepared so as to eliminate extraneous factors as much as possible. The bowels should be emptied, including flatus, by a brisk cathartic; and a light diet should be observed for a day or two beforehand, when permissible.

**Technic and Mode of X-ray Examination.**—This will be considered elsewhere. It may be remarked, however, that, as with ureteral catheterization, if one is guided solely by the symptoms and takes a radiogram only on the side complained of, one is liable to overlook evidence of great value that may exist on the opposite side. Unless the opposite side has been definitely excluded by ureteral catheterization as a source of trouble, it is advisable to take both the kidney and ureter of that side—always remembering that a shadow without the control of the radiograph catheter merely indicates the taking of another radiogram with such a catheter in place.

Kelly suggests that it is well to take a verifying plate a day or two following the positive finding or before a contemplated operation for stone; not only for verification but also for indicating a change in the position of a stone.

**Stereoscopic Radiography.**—This refinement of x-ray photography serves to place the shadow of a stone or foreign body with reference to the horizontal planes of the body. Used in connection with a radiograph catheter in the ureter it gives an attractive elucidation of conditions not otherwise rendered.

### FUNCTIONAL TESTS.

The integrity of the kidneys is universally recognized as being of great moment in its bearing on the risk involved by a given surgical operation. But this risk relates not so much to the anatomicopathological condition of the kidneys as to their *functional activity*. Consequently, while the information obtained by chemical and microscopic tests of urine is valuable, it is not the kind of information that is most useful in the case at hand. The pathological condition does not always parallel the functional activity. Some kidneys badly degenerated give urine that shows good excretion by reason of adequate compensation; while others apparently little involved may give urine very inferior in quantity and quality. Individuals with albumin and casts in their urine have been known to live for many years without apparent progress in the renal condition or decrease in the kidney activity. But the menace comes when the function is inefficient—even in the face of a sufficient quantity of urine and of fair quality. So insignificant an operation as a urethral catheterization may disturb the equilibrium that has existed, and be followed by suppression of urine and death. Such sequences have occurred even where the volume and quality of urine seemed to be satisfactory.

**Variability of Renal Function.**—This is marked in both health and disease; and depends on many influences. A glass of beer in a healthy person may double or quadruple the urinary output in the space of a few minutes. Functional activity that is lessened through disease may be restored by removal of the disease (acute nephritis) or its cause (a prostatic obstruction). Therefore the estimate should include not only the actual renal activity but also the potential capa-

bilities of the kidneys under better or worse conditions—for instance, in the face of an operation, especially a nephrectomy.

With the exception of hippuric acid the kidneys do not manufacture any of the waste products that issue from them. They simply extract them from the blood. It is the measure of this faculty of extraction that is desired. If the renal function is adequate, the waste products are excreted sufficiently and the blood is kept in its proper and healthy condition. If kidney activity is below the requirements of the individual, such products accumulate unduly in the blood or tissues of the body.

To determine whether this function is being properly attended to, it would seem proper to investigate either (*a*) the state of the blood, with reference to retention of waste products in it, or (*b*) the product of the kidneys (the urine), with reference to completeness of excretion. These tests would resolve themselves, then into (*a*) tests of retention and (*b*) tests of excretion (Hinman).

The tests of retention (cryoscopy of the blood, electrical conductivity) have so far not proved their efficiency or reliability. The nitrogen content of the blood has been found by some (Widal, Folin, Ovisannikova) to have much prognostic significance. When the blood urea, in a case of nephritis, rises to one or two grams per liter, the prognosis is considered a grave one; if above three grams, impending uremia and dissolution are expected. The normal limits are from 0.1 to 0.55 gram per liter.

The tests of excretion have found most favor because of their greater convenience and reliability. Apparently realizing the supreme value that would attach to the finding of an efficient test of this kind, students of the subject have submitted many different tests during the past decade. They have aimed at measuring the rapidity and completeness with which in a given case the test drugs were eliminated through the kidneys, and the relative activity of the two kidneys as tested separately; this, mainly to learn whether, if the diseased kidney were operated on or removed, the remaining one could fulfill the requirements of elimination and sustain life.

Endeavors at gauging functional activity or insufficiency by measuring the amount of the physiological waste products of the urine have proved unreliable. The chlorides, the phosphates, uric acid, the urates, urea, the total solids, etc., vary so much in health and the variations depend on such multifarious causes that they cannot be interpreted as having any relationship to operative risk or renal potentiality. The same thing may be said for the total quantity of urine. While it is of material value and definitely advisable to make use of these (urea, total solids, total quantity of urine, etc.) there yet remains something to be desired for determining functional activity.

For reckoning permeability, the following products have been found of most service: Phloridzin, methylene blue, indigo-carmin, phenol-sulphonephthalein (reduced for convenience to "phthalein").

**Phloridzin.**—The discovery by von Mehring that phloridzin renders the kidney very permeable to sugar led to its use as a test of renal func-

tional activity, and it seemed at first to promise much in this respect; but it was found that there was occasionally no elimination of sugar at all in perfectly healthy kidneys, while in others with only slight deterioration the test would apparently indicate serious degeneration. It has therefore not held the position at first hoped for it.

The manner of using the phloridzin test is as follows: An injection of 0.01 to 0.05 gm. of the drug in aqueous solution is made subcutaneously, intramuscularly or intravenously, the solution being freshly prepared and slightly alkalized with bicarbonate of soda, which favors complete solution. After ten minutes the urine is tested every minute with Fehling's solution until the appearance of the sugar is indicated in the usual way. Fifteen- or thirty-minute estimates of the output are then recorded. The sugar should make its appearance in from ten to fifteen minutes with normal conditions; reaches its maximum in one hour and gradually disappears in from two to three hours, with a total excretion in that time of one or two grams (Geraghty and Rowntree).

Indigo-carmin, methylene blue, and other anilin dyes have been praised in this light. The first is used by intramuscular injection of 20 c.c. of a 0.4 per cent. solution freshly prepared in sterile distilled water at room temperature (warmed before using). In about nine to twelve minutes after the injection is made, a greenish-blue tinge appears in the urine, with normal kidneys, and continues until about 25 per cent. of the injected drug has returned through the kidneys. But only 10 to 12 per cent. returns in an hour, and it continues showing for the next day or two.

B. A. Thomas<sup>9</sup> puts much faith in this test, but in addition to marking the promptitude of its appearance after injection, he seeks, as he terms it, the *index of elimination* of the drug; that is, he divides the quantity of indigo-carmin eliminated during the first hour by the quantity excreted during the third hour after injection. He found that the index for normal individuals in a series of cases averaged 5.1. If the amount eliminated during the third hour equals or exceeds that excreted the first hour, the patient's kidney function contra-indicates serious operative intervention.

The conclusions are based on the theory that disease of the renal parenchyma delays the onset of elimination and diminishes the early output as well, while the duration of excretion is prolonged; it therefore seemed to the author that the relative excretion for the first and third hours was of greater value than the mere quantitative output for the first two hours. Thomas considers this to be the safest guide to renal functionation of all the tests that have been proposed.

Methylene blue has been held in much the same esteem by its sponsors, Kutner and Casper, and later Achard. But by others it is rated of inferior merit. Investigation showed that in certain forms of nephritis there was none of the expected delay in the appearance of the green tint (normally nine to twelve minutes) after injection nor any interference with the rapidity of its excretion; while in some normal cases

the drug did not appear in the urine at all after the injection. Its unreliability condemned it.

Methylene blue is given by intra-muscular injection, fifteen minims of a 5 per cent. aqueous solution being used. Fifty per cent. of the drug comes back in the urine; the remainder is supposed to be converted in the body. The blue-green color should make its appearance in the urine within twenty to thirty minutes after injection, and may continue to show for one or two days thereafter. In some cases of nephritis it has been observed as persisting for fifteen days. In interstitial nephritis its initial appearance may be delayed for five or six hours, whereas in parenchymatous nephritis there may be no marked delay (Albarran; Bond; Hinman).

These instances serve to indicate the difficulty of finding a functional renal test that furnishes accuracy, reliability and innocuousness. Nevertheless one closely approaching the fulfillment of these exacting requirements has been found.

Phenolsulphonephthalein. This agent ("phthalein," for convenience) possesses certain properties and reactions, as described by Geraghty and Rowntree (1910-1912), that make it more nearly ideal than anything heretofore proposed. It is innocuous, even in large doses. It is secreted entirely by the kidneys and, in health, with punctilious uniformity, both as to time of appearance and rate of excretion. And this rapidity is so great that within two hours after it has made its appearance in the urine (beginning ten minutes after injection) from 60 to 85 per cent. of the drug passes out in the urine. This fact is doubly valuable, both for an estimate of the total function of the two kidneys, and for determining the relative functioning power of the two organs.

The rapidity of elimination shows variations dependent on the method and location of introduction of the dose. The response is slowest and least certain after subcutaneous injection; more prompt with intramuscular injection and most prompt with intravenous use. It is therefore advisable to use either the intramuscular or intravenous. The latter is particularly useful in connection with ureteral catheter drainage, the test being completed in fifteen minutes and permitting a shorter retention of the catheters in the sensitive ureters.

While it is practicable to determine the promptitude of appearance of phthalein in the urine after injection, it is not essential, and this is not nearly so important as the measurement of the amount of the drug excreted in the first and the second hour taken separately. After intramuscular use, the time of appearance is from five to ten minutes; the output for the first hour from 40 to 60 per cent.; for the second hour, 20 to 25 per cent. (making from 60 to 85 per cent. for the two hours). When administered intravenously in connection with ureteral catheterization, it appears in from two to eight minutes. The collection of urine for the fifteen-minute or half-hour period should begin with the appearance of color in either urine. To make the drug visible, a few

drops of sodium hydrate solution are placed in the test-tubes or vessels intended for receiving the urine drainage. Then, at the moment when excretion begins, a pinkish tinge appears, merging into a definite Bordeaux red by the additional flow.

In order that there may be no inhibition of urinary secretion from the presence of the ureteral catheters, it is advisable to have the patient drink one or two glasses of water before the beginning of the test.

Schmidt and Kretchmer<sup>7</sup> advise the collection of urine for three successive hours, believing that the excretion for each of three hours of the same amounts of phthalein indicates that the kidneys are working at top speed all the time because they are badly damaged.

**Relative Functional Activity.**—Where the quantity of urine, merely, is measured and the collection is made for ten minutes only, there may be a marked difference in the amount excreted by two healthy kidneys. But if the time of collection be prolonged for an hour or two, or perhaps if repeated at another time, this discrepancy is made up and the account balanced.

Excretion of phthalein, however, does not depend on the quantity of fluid excreted, whether large or small, and its relative findings are positive indications of functional activity, whether taken at long or short intervals. This, indeed, is one of the vital advantages of the test, making it both useful and reliable.

**Technic of Applying the Phthalein Test.—Intramuscular.**—Ampules containing about 20 minims of standard solution of Phenolsulphone-phthalein are supplied by Hynson & Westcott, of Baltimore, Md. Exactly one cubic centimeter is injected by hypodermic syringe deeply into the gluteus or any muscle of the lumbar region, the time of injection being noted. A soft-rubber catheter in the bladder drains the urine as it enters that organ from the kidneys. The drainage is caught in a white enamel vessel containing a few drops of sodium hydrate solution, which renders the phthalein visible on the instant of its arrival in the vessel. The appearance of the pink color marks the beginning of the first hour of the quantitative phthalein estimate. The catheter is withdrawn and is reinserted an hour from that time for obtaining the first hour's specimen. Sixty minutes later the second hour's specimen is obtained in the same way (unless the patient can be depended on for completely emptying his bladder by voluntary urination, default of which vitiates the result). The phthalein percentage of the two hours' excretion is then determined by adding to each specimen respectively enough water to make 1000 c.c.; placing a few cubic centimeters of this diluted specimen in the cup of the colorimeter of DuBoseq, which by comparison with a standard solution at once gives the required percentage. The same is then done with the diluted specimen from the second hour's excretion and its reading recorded. When ureteral catheterization is employed for determining the relative functional activity of the two kidneys, the intravenous method should be used and the time lessened as previously suggested. Fifteen minutes (one-fourth of an hour) is the customary period used, and its result

is multiplied by four for the full hour. This represents the output of each kidney, which, added together, gives the output of both kidneys. In the first fifteen minutes a normal kidney should put out half of about 30, or 15 per cent. (G. G. Smith). If one kidney is diseased and putting out less than the normal (less than 15 per cent.), the other may be compensating and putting out more than 15 per cent. Hence the value of making the comparative functional test by ureteral catheterization.

In women the average output is slightly lower than in men.

In summing up, it may be said that no one test should be relied on as all-sufficient, but that a working combination of two or three should be utilized. The daily output of urine-urea and solids, the quantity of urine, together with phthalein estimate, repeated as necessary, should be prominent among the factors determining the question of operation and prognosis.

According to Cabot, the *stability* of renal functionation, established by successive tests, is of greater moment than a high functional percentage. Patients who under strains of exercise, changes of diets or alterations in quantity of water vary markedly in their renal output are less favorably considered than those having a lower index which is well maintained under these influences.

### EXAMINATION OF THE URINE.

While the conventional steps of urine examination will not be considered here, it may be profitable to express some thoughts on the subject that clinical experience has indicated as of frequent and practical importance.

Examination of the urine may be of incalculable service in tracing the location and nature of a genito-urinary affection. But it must be made understandingly and not in the stilted, routine fashion ordinarily carried out. Many think that if they have learned whether a patient's urine contains albumin or not their full obligation in that direction has been discharged. As a matter of fact, such a return may offer no enlightenment on the case, one way or another. Aside from the evidence on renal functional capability, considered elsewhere, the pertinent questions to be answered are, what pathological elements does the urine contain; and from whence do they come? Eminently practical questions, both, and answerable by definite methods of investigation. Volumes have been written in the endeavor to make the source of urinary disturbance recognizable by means of the particular shape or other characteristics of epithelia formed in the urine; that caudate epithelia mean pyelitis, etc. To the mind of the writer this is mere waste of time; and illusory. More exact methods are those which trace the epithelia or pus cells or other pathological findings to their source by the definite means of cystoscopy, ureteral catheterization and radiography. Mark Twain said that when he dined at a boarding house he always called for hash because he wanted to *know* what he was eating.

In this work one wants to *know* one's evidence, putting doubt and speculation as far behind one as possible. One should never assume an ability to name the contents of urine by viewing it macroscopically; yet this assumption is practised habitually by some. Many a specimen of urine looks limpid clear and innocent, yet contains blood cells, pus corpuscles or tubercle bacilli; and these spell pathological conditions.

**Cloudy Urine.**—The clouding of urine, apparent to the naked eye as viewed in the urine glasses, may come from the admixture in it of precipitated urates or phosphates, of spermatozoa, pus cells, blood cells, epithelia, bacteria, parasites of various sorts, and foreign material (dirt), and crystalline formations.

It should be the first object of the investigator to learn the cause of the clouding. This is accomplished to best advantage by means of the microscope after sedimentation.

To propose a sequence, then, of steps of urinary examination, it is well to begin with the double-glass urine specimens that have been passed voluntarily by the patient and described on page 115. In inflammatory conditions the second portion is usually the clearer of the two and the one less influenced by disturbances in the anterior urethra. In passing outward, the first part of the urine carries not only the materials it has collected in the bladder and upper urinary tract, but has added to it products from the urethra; hence its greater cloudiness. Exceptions to this occur when, in the final contractions of the vesical and post-urethral muscles, blood is squeezed from an acutely inflamed vesical neck; or incidental to the same act, there is the passage of spermatozoa from the seminal vesicles into the second part of the urine. Then the second part is bloodier or cloudier, as the case may be, than the first.

If the clouding be due to precipitated phosphates, it may be cleared by the addition of a few drops of acetic acid; if due to precipitated urates, warming the specimen over a Bunsen burner will cause them to redissolve. But if these simple measures do not at once succeed in clearing the urine, resort must be had to the more definite plan of *seeing what is causing the clouding*; and this should be done while the specimen is fresh and unchanged by decomposition or bacterial invasion. It is to be accomplished by microscopic demonstration, to which no chemical test or other method is comparable in accuracy or completeness. The specimen of urine is sedimented by centrifuge; the sediment is placed unstained ("fresh specimen") under the microscope, enabling the investigator to see whether motile bacteria, pus cells, crystals, blood cells or what not produce the clouding. Staining of the same sediment brings bacteria, when sparse, into more prominent view, and permits their differentiation; so that it should be the next step of the investigation. Naturally the staining must accord with the requirements of bacteriology and must be varied according to the kind of organisms suspected to be present; but methylene blue is a convenient and serviceable stain to begin with. If, in a sus-

pected gonorrheal case, this dye demonstrates diplococci that appear to be gonococci, they must invariably be proved to be such by means of the Gram stain. If the fuchsin stain appears to demonstrate tubercle bacilli they must be proved to be such by measures that leave no room for doubt. These include methods of acquiring the urine specimen that at the same time exclude the possibility of contamination with smegma bacilli, and may include inoculation tests, as well. The question of differentiating between tubercle and smegma bacilli by processes of staining alone has been discussed elsewhere (page 118) with the conclusion that no such possibility should be entertained. In both sexes the urine for tubercle bacilli demonstration should be obtained by catheterization and after careful cleansing of the external genitals. *With but few exceptions it may be said that the finding of tubercle bacilli in the urine means tuberculosis of one or both kidneys.* That truth, the determination of which has been within the past decade, has been of immeasurable service to sufferers from urinary tuberculosis—leading the surgeon to disregard, as of secondary import, the tuberculous implication of the bladder and go straight to the source of trouble, one or the other kidney; remove it and reclaim the patient to health and the enjoyment of living.

It is true that tubercle bacilli have been found in the urine of patients who had no renal involvement, but were tuberculous elsewhere, the bacilli apparently having been filtered through the sound kidneys after being conveyed by the blood from the original focus. But the discovery of tubercle bacilli under such circumstances is so rare that it should be viewed more as a pathological curiosity than a reality to be reckoned with in the clinic. Practically, then, tubercle bacilli in the urine means renal tuberculosis. The next question is, which kidney? As mentioned elsewhere (page 122), ureteric meatoscopy through the cystoscope, though relied on by many, should be supplanted by the surer method of ureteral catheterization, by which means is learned not only which kidney is to blame for the tuberculous infection, but also the condition of health and functional activity of the other organ. The answer to both of these questions is absolutely demanded in a complete diagnosis.

**The Absence of Tubercle Bacilli.**—The inability to find tubercle bacilli in a suspected urine should not at once lead to false hopes of their absence and to what may later prove an erroneous diagnosis of non-tuberculous infection. While latter-day methods have increased the ability to find the bacilli when present, it must be remembered that even with active and severe renal tuberculosis there are periods in which the bacilli do not appear in the urine. They seem to be pent up for the time being in the suppurating pockets, to escape periodically in the so-called showers of the organisms, easily demonstrable then in countless numbers. The necessary deduction is that in a suspected case a failure to find tubercle bacilli should count for nothing and should be followed by many repetitions, if necessary, of the endeavor.

**Guinea-pig Inoculation.**—A measure that often proves successful in the face of failure by direct microscopic investigation is that of inoculating a guinea-pig (or two) with the sediment of suspected tuberculous urine. Too few to be detected by the microscope, the bacilli are numerous enough to respond positively to this more refined method and develop tuberculosis in the animal, showing within two to four weeks. But this also is not absolutely reliable as to negative evidence, since it is established that failure to inoculate has happened with urine that later was proved to be tuberculous by postmortem demonstration. A failure of this sort may be due to the fact that the attempted inoculation is made during a quiescent period, between showers of bacillary excretion, or to some other cause. At any rate, because of the unreliability of the various phases of negative evidence, one is reduced occasionally to make a diagnosis instinctively, so to speak: *Feeling*, from the several aspects of the case, that it is tuberculous at bottom, even though the ultimate proof, demonstration of the presence of the tubercle bacillus, be lacking.

**Tuberculin Tests.**—Tuberculin tests may be used in cases of suspected urinary or genital tuberculosis, and occupy the same position as when the focus of infection is located elsewhere in the body. Its positive reactions are similar, consisting of the well-recognized chill or chilliness, temperature, aching sensations; and in urinary infection, local reaction of various sorts: Increased pain during urination, increased frequency, occasionally hematuria or increase in a hematuria already present.

Radiography can be of assistance only in the late stages of a renal tuberculosis when it demonstrates the shadows of caseous masses in a badly damaged kidney. When this condition is reached, the diagnosis has doubtless already been made by other methods.

**Examination of Urine Drawn by Ureteral Catheters.**—It is not always practicable or desirable to draw a considerable quantity of urine for examination after ureteral catheterization. Both the time of the surgeon and the safety of the patient militate against this. Fortunately, it is not necessary. Two or three drams of urine are usually sufficient for practical purposes. The separated urines should be put through the same processes of examination as have been applied to the other specimens. Albumin due to the presence of the catheter in the ureter will nearly always be found, and is therefore a negligible element. Sometimes casts appear for the same reason. Blood cells often are present from the same cause. But as these may all have been absent in the specimens previously examined, they are recognized as having no significance. If there are sufficient blood cells present to interfere with steps of the examination, they may be at once dissolved and eliminated by adding a few drops of acetic acid to the specimen, or, better, a drop of the acid to the sediment on a slide. This also clears up the pus corpuscles and leaves their multinuclei plainly discernible as compared with leukocytes, white blood cells, etc. Round epithelia are usually present in abundance in the specimens acquired by ureteral catheterization, and do not always indicate pathological conditions,

especially if unaccompanied by pus, bacteria or other evidence of disease. Specific gravity of small quantities of urine is obtained by using gravity beads in small test-tubes; but this, also, is of lesser import, influenced as it is by many accompanying conditions, excitation or inhibition of renal excretion from instrumentation.

Aside from the determination of the relative functional activity of the two kidneys (discussed elsewhere), the chief objects to be attained in examining ureteral catheterized specimens are: Learning whether pus or bacteria (including tubercle bacilli) are present, and making the differential recognition of the organisms found; learning the exact source of bleeding which is present before the catheterization; comparing the relative activity of the two kidneys with regard to quantity of urine secreted in a given time. (For insuring against error in this, precautions must be taken with reference to leakage on one side or the other alongside the catheter into the bladder, instead of draining through the catheter); and relative functional activity.

**Complement Fixation Test.**—In inflammatory conditions of the urinary tract, when intracellular groups of diplococci are found by methylene blue or other of the anilin dyes and they are decolorized in the Gram stain, the diagnosis of gonococcus infection is fixed irrefutably. But if in the face of symptoms and history simulating those of gonorrhea, or if there is a question of recovery from gonorrhea and none of the organisms can be found, the question as to whether the gonococcal element prevails may be a momentous one, yet difficult of solution. The tests of irritation (beer, nitrate injection, use of urethral sounds) may all fail and leave the investigator in the dark. Cultural methods are not always satisfactory or available. To meet this dilemma the complement-fixation blood test was devised by Müller and Oppenheim in 1906, the efficacy of which was confirmed by Schwarz and McNeil<sup>8</sup> whose contribution on the subject was highly appreciated by the profession. Others investigated the efficiency and reliability of this test and reports of Swinburne, Schmidt, Gardner and Clowes, Gradwohl and others gave strong support to the favorable estimate early placed on it.

The test is somewhat analogous to the Wassermann test. It is based on the fact that microorganisms, when mixed with their homologous antisera, are capable of rendering complement inactive or fixed, as shown by the absence of hemolysis when sensitized erythrocytes are added to the mixture. The antibody is produced in the patient by the gonococci, and the antigen is a preparation of the gonococci. The fixation of complement is a result of the specific interaction between the two. For details of preparation and use, see the papers by the authors alluded to (*Trans. Am. Urolog. Assn.*, 1911–1912). The test is now available in practically all modern laboratories, and should be used whenever the other modes of diagnosing suspected gonococcal infection prove unsatisfactory or uncertain.

**Wassermann Tests: Blood and Spinal Fluid.**—That the Wassermann blood and spinal fluid tests have great practical value in assisting in the

solution of obscure cases of urinary obstruction and other chronic genito-urinary disturbances, is becoming widely recognized. These tests should be applied without hesitation in all cases, young or old, whose etiology is not traced or understood. The writer has found syphilis to be the basic and controlling factor in a number of cases of prostatic obstruction, urinary retention and vesical atony—cases in which there had never been the slightest suspicion of such infection, although it had evidently been present for years. Even hereditary syphilis has been observed in the same light, causing chronic and severe urinary obstruction from infancy to adolescence, the patient meantime being put through a number of operative measures and treatments that served only to aggravate his sufferings. This topic is discussed at greater length in a paper by the writer, “Studies in Obscure Forms of Prostatic Obstruction and Vesical Atony.”<sup>3</sup>

The chronic retention of urine from locomotor ataxia is but a similar manifestation of syphilis and its late effects on the spinal cord. The *modus operandi* of the production of retention in these and similar cases has been expressed by the writer<sup>1</sup> as follows: The normal filling and emptying of the bladder is accomplished by a well-balanced relationship between the detrusor and sphincteric muscular systems of the bladder. If there is incoördination or loss of balance between these two systems, there is derangement of the function of urination. If the sphincteric function be weakened or abolished, there is leakage or incontinence; if the sphincteric energy be excessive, as compared with detrusive power, there is retention. Sphincteric energy is relatively stronger when the detrusors are weakened from any cause. In atony, for instance, while the sphincters may not actually have gained any strength through the establishment of that condition, they offer sufficient resistance to the now weakened detrusors to interfere with the discharge of their function; a certain amount of urine is left over after each urination. The insertion of a catheter removes the effect of the sphincters, opens the outlet and restores the original balance between the two opposing systems. The detrusors demonstrate their remaining, though weakened, power and readily empty the bladder.

It is incumbent on the diagnostician to differentiate between these conditions, and also to trace the cause of the disturbances described.

### **CARDIOVASCULAR EXAMINATION.**

As suggested under a previous heading, an examination of the allied organs, the kidneys and cardiovascular system, is of the utmost importance in its bearing on the outcome of a contemplated major surgical operation; and may have much to do with success or failure in non-operative plans of treatment in certain affections, especially of the kidneys. Cardiac functioning is intimately associated with renal activity and competence. Nothing shows this more plainly than the success that frequently follows the prescribing of efficient heart tonics in the presence of lagging kidneys. The heart grows energetic,

circulation becomes better, the kidneys respond with more and better urine and improvement becomes manifest in every respect.

In determining the condition and efficiency of the heart and vascular system, besides the methods of examination regularly employed, the blood-pressure should be accurately taken. Some operators consider this to be as important as the urinary findings as a gauge on the physical condition and powers of resistance to the shock of operation. A pressure unduly high or low may well be considered as directly suggestive of the propriety of postponing a contemplated operation until such time as various corrective measures may bring about a more favorable condition.

### DIAGNOSIS OF OBSTRUCTIONS IN THE URINARY TRACT.

Obstructions in the urinary tract must be diagnosed with reference to (a) location; (b) form and nature; and (c) severity. They occur at any point between the preputial orifice, and the urinary tubules of the kidneys. There are definite and well-conceived methods of attaining the above-mentioned objects in diagnosis.

**Urethral Obstructions.**—Obstructions located at the preputial or external meatal orifice are patent to observation and require no comment other than a gentle expression of regret that physicians do not always make even the cursory inspection of these parts that would locate the source of trouble, which is often on that account severe and unnecessarily prolonged. In children kidneys have been destroyed through backward pressure from so simple a cause as a narrow meatus or a tight prepuce. The tissues surrounding a narrow meatus gradually merge into a dense fibrous ring, producing, through backward pressure, insidious but disastrous effects on the organs above. Invalidism and a shortened life may be the consequence.

Obstruction of the urethra at any point offers little difficulty of detection. Suspicious symptoms or history should lead to direct examination of the urethra by bulb sounds, which, the larger sizes being used first, will demonstrate the "hitch" of a stricture, its size and extent; or the obstructive presence, and possibly the grating feel of a foreign body.

The bulb sounds are useful for the anterior urethra, but the large size conical steel sounds are preferable for the posterior part of the canal. A tight stricture at this point will obstruct a steel sound without the objectionable grasping of the bulbs. E. G. Mark<sup>1</sup> expresses his belief that one of the most satisfactory methods of diagnosing urethral stricture is that by means of the *aëro-urethroscope*. This gives a plain and clean-cut view of the constricted area, as well as of the adjacent healthier portion. Such a view also leads to more definite indications as to the treatment, it is claimed.

**Obstruction at the Vesical Neck.**—The demonstration of obstruction located at the vesical neck rather than at some point in the urethra is

made in the following way: In a given case the symptoms of which point to obstruction somewhere, the patient is instructed to pass his urine (all that he can) by voluntary effort; after which a soft-rubber catheter is passed if possible into the bladder. This immediately shows whether or not residual urine has been left over after the voluntary urination. Five, ten or twenty ounces residual urine thus obtained *is clear evidence of marked obstruction*; and also that *the obstruction is located at the neck*. So marked an obstruction as this (5 to 20 ounces residuum) if in the form of a urethral stricture, would stop the passage of a soft catheter before it arrives at the neck; whereas, prostatic obstruction, in the first place, does not make itself evident to a catheter until the depth of the vesical neck is reached; and, in the second, prostatic obstruction is usually surmounted by a soft-rubber catheter of good size and quality. In brief, therefore, the drawing off, *by means of a good sized rubber catheter* (No. 18), of a pronounced amount of residual urine after voluntary urination *indicates obstruction at the neck*. If, on the other hand, the progress of the soft catheter is suddenly stopped before reaching the vesical neck, we know the obstruction is urethral; and in all probability is either a stricture or a manifestation of the obstructing influence of the cut-off muscle (compressor urethræ). The differentiation between these is made by means of the bulb and conical steel sounds. The muscle offers obstruction to the bulbs but not to the steel sounds. Pronounced stricture offers obstruction to both. By these tests, then, is learned (a) whether there is obstruction; (b) the severity of the obstruction; and (c) its location.

If the obstruction is thus found to be located at the neck, the problem resolves itself into the determination of the remainder of the diagnostic points previously described, namely, the form, character and other physical characteristics of the obstructing factor at the neck; and the determination of the condition, functional activity, etc., of the allied organs, the heart and kidneys.

From the view-point of obstruction, the vesical neck is undoubtedly the most interesting part of the urinary tract. While many forms of obstruction here met with are readily differentiated under the plans of examination already described, there are many others in which the cause is not easily determined. It may be obscure and may never be identified. The patient then is either classed as incurable or joins the host of "journeymen patients" who go unrelieved through the hands of physicians, thence to quacks, to osteopaths, "scientists" and down the line of fakery.

With its importance and far-reaching influence in mind the writer, in discussing this subject at length elsewhere,<sup>3</sup> expressed himself as follows: "The causation of urinary obstruction should always be found in one of two factors, namely, (a) physical obstruction of some kind or (b) disturbance of the nervous mechanism controlling urination (tabes, spinal or cerebral lesions, etc.). There is no such thing as 'unaccountable' atony or urinary retention; such a term represents incomplete diagnosis. The most frequent and important

of the obscure, unrecognized causes of obstruction are: (a) Ill-defined contracture at the vesical neck demonstrable sometimes only by palpation through the opened bladder or urethra; (b) unrecognized syphilis, acquired or hereditary, affecting the spinal centres. Such conditions are by no means confined to adult life, and should be looked for at any age, from infancy up; diagnosed and treated in accordance with the refined diagnosis always demanded in cases of urinary obstruction. A final, but too late recognition is but poor solace for a lifetime of suffering due to delinquencies in diagnosis."

**Causes of Obstruction at the Vesical Neck.**—The causes of obstruction at this point are multifarious. They include disturbances both local and general or internal, primary or secondary, congenital or acquired, and are capable of being subdivided as to etiology as follows:

*Local causes:*

1. Prostatic overgrowths (adenoma);
2. Contracture;
3. Cyst formation;
4. Abscess;
5. Congestion or Inflammation;
6. Neoplasm, benign or malignant;
7. Calculus;
8. Foreign body;
9. Valve formation in prostatic urethra;
10. Cyst or tumor of verumontanum;
11. Inflammation of seminal vesicles;
12. Infection (colon bacilluria of little girls);
13. Hemorrhage (clot formation).

*Internal or systemic causes:*

1. Cerebral (meningitis, hemorrhage);
2. Spinal (paresis, tabes, spinal syphilis);
3. Habit (deferred urination of teachers and others);
4. Fatigue (Peyer);
5. Neurotic (hysteria, nymphomania);
6. Psychic (fixed idea);
7. Reflex (secondary to irritations originating elsewhere; post-operative; shock).
8. Toxic (alcoholism, diabetic coma; acidosis, effect of drugs).

The number and variety of causes of obstruction at the vesical neck afford no excuse for not making the required recognition and differentiation. Indeed, these must be made in order to choose an appropriate treatment. Aside from an intelligent study of symptoms and signs, the cystoscope and posterior urethroscope afford the greatest assistance in arriving at diagnostic conclusions. These instruments are not interchangeable. A lens appropriate for the close-vision work of urethroscopy is inefficient and inappropriate for cystoscopy; and the relatively long distance focus of the cystoscope lens is inappropriate for intra-urethral vision. For discussion of diagnostic instruments see page 118.

**Obstruction in the Bladder.**—Obstruction and urinary retention sometimes occur from causes located within the bladder itself; such as foreign bodies, stones, tumors, etc.; or diverticula, whose lack of muscular equipment prevents them from contracting and emptying their contents into the bladder cavity. Cystoscopy is the chief agency for determining the diagnosis in such cases, although much may be done with radiography, using collargol or silver iodide solutions for distending the bladder. Deviations from normal size and form are thus to be recognized.

**Obstruction in the Ureter.**—Ureteral stricture is not as rare a condition as its lack of recognition in general would indicate. Occurring independently, or in connection with ureteral stone, the symptoms of both are often intertwined. Mucopus plugs passing down a ureter and becoming impacted in a strictured area act like stones and are followed by similar consequences of distention, pain, colic, chills or fever and infection. The effects resemble those of stone colic so closely that the differentiation is often made only with difficulty and with the aid of ureteral catheterization and radiography. A catheter is usually obstructed or stopped in its passage up the ureter on coming in contact with a stricture; and is frequently, though not always, obstructed by the presence of ureteral stone. But the progress of a catheter may be stopped from too great angulation of the ureter channel or from spasm of the ureteric muscles, to be overcome in both instances by appropriate measures: Changing the course or direction of the catheter, in the first, and making steady pressure with the catheter and awaiting relaxation of the spasm, in the second will usually overcome the abstacle. A ureteral band, pressure from an anomalous vessel or adhesions, are other causes of ureteral obstruction whose differentiation is assisted by catheterization and pyelography. The efficiency of these measures in diagnosis has gradually lessened the utility and necessity of the old stock reliance, exploratory operation, in surgery of the upper urinary tract. Time was when surgeons opened the bladder to see whether or not the prostate was enlarged, but such a procedure would hardly be countenanced now except in the presence of very complicated conditions.

**Obstruction in the Renal Pelvis.**—This is produced by stone formation, constriction from stricture, adhesions, kink, anomalous vessel, or malignant growth, and sometimes from plugging of the outlet by the products of inflammation, crystalline sedimentation, or hemorrhage.

The typical characteristic distress-signal of Nature indicating any of these conditions is pain, intense, repeated, horrid; described by some as possessing all the tortures conceivable. Where the stone forms in the kidney tissue, especially in the cortical portion, the pain is less insistent; indeed, it may be insignificant or even absent throughout the progress of destruction of the organ. But this well-established fact should not justify a failure to trace and find the offending stone, no matter how insidious its development nor retired its situation. Investi-

gation along the lines of *comprehensive physical examination* should divulge the secrets of all cases and evoke relief before the period when decrepitude and participation of the opposite kidney preclude chances of reclamation.

Pathological evidences of obstruction in the pelvis consist in hydro-nephrosis, pyonephrosis, thinned, sacculated and destroyed kidneys, the latter being sometimes nothing but a thin-walled sack, incapable of excreting real urine, but perhaps carrying on a process of filtration of thin, worthless fluid incapable of performing the renal scavenger service required for life and health.

### SYMPTOMATOLOGY IN GENITO-URINARY DISEASES.

The writer has always considered the extended discussion of urologic symptomatology as detrimental to the attainment of correct and useful diagnosis, rather than the contrary. Such symptomatology is inexact and often illusory, as has been previously shown, and cannot be given much credence even by the initiated. How much less reliance, then, can be placed on it by those who are doing general practice and do not possess experience in this special work that would keep them out of the pitfalls ever present. The symptoms under such circumstances assume more the character of will-o'-the-wisps, leading practitioner and patient on and on from one erroneous assumption to another, the while postponing the day of definite reckoning, exact diagnosis and correct treatment until the arrival of the unhappy time when everyone realizes that it is too late; that opportunity has fled from the poor sufferer, leaving in its wake only the miserable duty of palliation until death relieves. The betrayal has been made through the guile of plausible but illusory symptoms.

Used in their proper light, however, urinary symptoms are valuable and serviceable for paving the way to recovery. They should be received as pointing the way, not to diagnosis, *but to appropriate methods and steps of physical examination*, on which must rest the development of the diagnosis. This is a real situation in urology and is met with every day of the year, the country over. Its consideration, therefore, and its reiteration are worth while. Whatever is said of symptomatology, in this or any other review, should be said with those thoughts ever in mind.

**Symptoms of Urethral Affections in the Male.**—The anatomico-physiological division of the male urethra into anterior and posterior portions markedly influences the symptomatology of this tract. Between the placid progress of an anterior urethritis and the urgent and impetuous invasion of the posterior urethra there is a wide difference. Frequency and urgency of urination usually mark the transition; and inspection of the urines confirms the suspicion: The two (or three) glasses are found to be cloudy, instead of the clouding being confined to the first glass, as has been the case up to that time.

With subsidence in the intensity of the posterior inflammation there

is usually decrease in the unwonted frequency until often, even with persistence of a low-grade inflammation and moderate infection there may be no greater frequency than normal. Also, under the same circumstances, there may be no purulent discharge at the external meatus; and if one were guided by symptoms alone, he might pronounce such a patient well and permit him to resume intercourse though he were as infectious as during the more active stages.

In the misconception that undue frequency of urination means cystitis, the irritative symptoms of posterior urethral infection are often ascribed to the bladder. As a matter of fact, the sensation of desire to urinate arises in the posterior urethra, and excessive frequency is an indication of irritation of the posterior urethral membrane. Were the bladder mucosa the seat of the sensation, desire to urinate would be aroused practically all of the time, as the bladder nearly always contains some urine—even shortly after urination, when it is refilling.

**Vesical Symptoms.**—Pain deep in the pubic region and a disagreeable feeling of fulness are often present with cystitis. In connection with the presence of a stone in the bladder there is described by the patient the sudden interruption of the urinary stream and, after a pause, the resumption of the flow. These are the most characteristic symptoms pointing to disturbances within the bladder. But they are not to be relied on for differentiation, even with the addition of blood in the urine, as the same conditions and interruptions may be brought about by the presence of a pedunculated tumor in the bladder, intermittently plugging the outlet and interrupting the stream as does the stone.

**Prostatic and Seminal Vesicular Symptoms.**—A symptom almost constantly attendant on prostatic inflammation, either from abscess formation or in connection with acute retention from hypertrophy, is pain in the glans penis. Complaint of such pain, in the absence of apparent disturbance of the glans, should arouse suspicion of prostatic disturbance and lead to the rectal palpation that should determine the question. Active irritation in the vesicles often produces an uncomfortable “bearing-down” feeling in the perineum with a sensation of fulness there; or, the pain may be transmitted down the spermatic cord into the testicle of the side affected. Chills or elevation of temperature in connection with any of these conditions depend on the acuteness and intensity of the process, and may or may not be present.

A sign of atonicity of the ejaculatory ducts is given in the recurrent escape with urination of spermatozoa from the seminal vesicles. Significant evidence of this appears in the two-glass urine test: In this case the *second glass* is cloudier than the first, an exception to the rule as already mentioned. The clouding, on microscopic examination, is found to be from numbers of spermatozoa.

**Ureteral Symptoms.**—Ureteritis sometimes presents symptoms, sometimes not. If present, they may show as a fixed or intermittent pain in the line of the ureter, extending downward into the scrotum and testis of the corresponding side; to which may be added an irritation reflected into the posterior urethra that evokes frequency of urination or even

strangury. Tenderness in the line of the ureter is also characteristic of ureteritis. This is accentuated when one comes to catheterize that ureter through the cystoscope; and further confirmation is obtained in the contents of the urine drawn from that side: pus, bacteria, epithelia and blood cells.

**Ureteral Stone.**—By blocking the ureter and damming the urine back into the kidney, and also by arousing spasmodic contractions of the ureteral muscles, ureteral stone often becomes one of the most painful conditions affecting the human body; and such attacks may recur at irregular intervals for many years, subjecting the patient to the mortal dread, as well as the realization of their horrors. When the stone is smooth and oval, and leaves room for the passage of urine beside it, there may be no more than an occasional dull ache in the vicinity of its location; and this, notwithstanding that the kidney above it may be undergoing damage and gradual destruction through infective and insidious back-pressure influences. Nausea and vomiting often occur in connection with such ureteral crises.

**Renal Pelvic Symptoms.**—Chronic backache that has, by the laity, been ascribed to “kidney disease” is more closely and typically connected with pyelitis than with nephritis, of the chronic form. The amount and intensity of pain caused by a stone in the pelvis depends largely on whether it falls into the ureteropelvic outlet and blocks the escape of urine. But even aside from that it may be said that a stone moving about in a pelvis and thereby irritating it arouses much more pain than does the stone that grows while fixed immovably in the cortex, even though the destructive effect may be as great with the latter. Many cases have been observed in which kidneys had been utterly destroyed—found so at postmortem examination—without any complaint of backache having been made during life.

Probably the most typical sign of severe pyelitis is the persistent loading of the urine with pus, continuing perhaps over many years. The very absence of other symptoms in the presence of excessive pyuria is in itself sufficient to cause a suspicion of pyelitis and call for the cystoscopy and ureteral catheterization that are needed to solve the question. Of course the determination of pyelitis by such means is only one step in the procedure, and the *cause* of the pyelitis is also to be learned: Whether from stone, tumor or infection; and if the latter, what kind (colon bacillary, tuberculous, gonococcal, etc.). It is surprising how long such pelvic suppuration may go on without making marked inroads on the general health of the patient. A patient of the writer showed urine that by bulk was almost a third pus on settling, and declared that the same thing had been going on for twenty years; and without apparent detriment to his general health.

Movable and displaced kidneys produce symptoms of pain and systemic reaction, nausea and vomiting harmonizing with the occurrence of displacement and obstruction to circulation and urine escape incidental thereto. Such attacks are called Dietl's crises, a term given in recognition of their graphic description and explanation in 1864, by Dietl.

**Genital Symptoms.**—Symptoms of pain connected with diseases of testis or scrotum are sufficiently localized to disclose their identity, with certain exceptions. The writer recalls an instance in which a bed-ridden patient was crying out with complaints of pain in the back and could give no clue to the cause until an extended search disclosed the existence of acute swelling and inflammation of one testicle, of which the patient was not aware until it was shown to him. It showed where the reflexes of testicular pain might be looked for: Up the cord and into the back. Disturbances of the cord tend to reflect pain in the same direction.

**Urologic Symptomatology in Women.**—**Urethral Symptoms.**—In women the short urethra is undivided by a cut-off muscle, and the symptomatology presents no such variations according to location of involvement as are found in the male. The female urethra, nevertheless, is the source of much suffering and intensely painful symptomatology, which, curiously enough, is nearly always ascribed to the bladder by the sufferers. Designated as “cystitis,” such urethral irritations, inflammations and contractures go for years, often with no better treatment than some internal medicine and perhaps an occasional washing of the bladder—an organ that is merely an innocent bystander in multitudes of such instances.

The symptoms complained of, then, are undue frequency and urgency of urination, often painful urination, accompanied with straining or incomplete emptying of the bladder; and all with or without clouding or infection of the urine. Some patients show crystal-clear urine yet complain strenuously from adolescence to middle life. Some relate that the same conditions have prevailed since childhood. Others give the birth of their first child as the date of beginning; while still others note the close and suspicious relationship between marriage and the beginning of their “bladder trouble.” At any rate, like the poor, it seems ever present with them. A recent patient of the writer was certain that she had had the same symptomatology for thirty-eight years; yet she became well within a month after appropriate treatment, based on a correct diagnosis, had been applied. In this case the urethra only was involved, in the form of a narrow stricture at the meatus, causing obstruction and urethritis behind it.

In these conditions, as well as in those in which the female vesical neck is particularly involved, the symptomatic expression is chiefly frequency of urination and an inability to retard urination when once the desire is felt. It occurs in the young, the middle-aged and the old. Vesical symptoms, pain and aching feelings often originate from disturbances in the uterus or malpositions of that organ, causing it to impinge on or distort the bladder. Cystoscopically, one may often see the dome-shaped body of the fundus uteri as it encroaches on the bladder cavity.

The symptomatology of the remaining urinary organs of women do not differ materially from that described for men, and requires no further special mention.

Hematuria, pyuria, bacteriuria when sufficiently pronounced are evi-

dent to the naked eye, and on being thus observed should always impel the practitioner to make or have made the definite investigation that should disclose their source and causation. *Under no circumstances short of actual danger from loss of blood* should an endeavor be made by medicines, etc., to check hematuria until opportunity is had for cystoscopic diagnosis of the source and causation of the bleeding. It is of greatest importance to have the cystoscopy done *while the bleeding is going on*. When it stops, the urine may be as clear as crystal and give no tangible evidence of whence came the alarming hematuria of a few days previously. To bring about a temporary clearing of the urine of blood is no real accomplishment and postpones the making of a definite diagnosis; so that the more successful the practitioner is in that endeavor, the more he is liable to injure the prospects of his patient.

To depend on the color of the blood as indicating whether it has come from bladder, ureters or kidneys, is fallacious in the extreme and should not be entertained for a moment. The crucial test is the use of cystoscopy and ureteral catheterization, with possibly the addition of radiography.

Phosphaturia, oxaluria, uric acid excess and other like conditions are indicative of disturbances of metabolism. Their irritating influences sometimes excite an irritation of the urethra that may become quite an active urethritis, not easily controlled unless the causation is recognized and is eliminated at the source. The writer has seen cases in the males that, excepting for the absence of gonococci in the discharge, closely resembled gonorrheal urethritis. These are among the so-called "simple urethritis" cases. The diagnosis is arrived at by examination of the urine and identifying the causal element therein.

**Physical Examination of Women.**—The patient should be cautioned against taking a douche or urinating shortly before undergoing examination—something that prospective patients are prone to do. Such action only washes out the inflammatory products and disguises the real situation. If the woman is being examined because of a suspicion of gonococcal infection, inspection of the external genitals should be the first step, a little pressure with the finger being made under the meatus to express any urethral discharge that may be present. If none is found, the meatus may be cleaned with moist cotton and the patient requested to urinate in a sterile vessel, both for macroscopic and microscopic examination. Such a urine specimen will contain vaginal epithelia in abundance; and if urethritis be present, evidence of it will be shown in the pus and other inflammatory products, possibly with gonococci, attained by sedimentation and staining. If it is desired to examine for tubercle bacilli, the specimen for this purpose should be drawn by catheter directly from the bladder.

Continuing the physical examination, a vaginal speculum is introduced and the cervix is inspected. Some of its secretion may be mopped up with a small cotton swab and transferred to glass slides for staining. It is scarcely worth while to take secretion from the vaginal wall, as the bacteria are naturally so numerous in the vagina that no particular

forms can be identified in this way. The cervical canal and uterine cavity may be sounded by the uterine probe, for information as to depth and conformation. The remainder of the physical examination is to be made by bimanual palpation, with the patient on the back and legs and thighs flexed to the degree of affording most relaxation to the abdominal muscles.

Bimanual palpation gives information not only as to the size, shape, mobility and position of the uterus, but often gives valuable information regarding the bladder and ureters: As to whether they are thickened, tender, severely inflamed, etc.; and sometimes a ureteral stone may be felt in the lower part of the ureter.

Bimanual palpation of the kidneys should be made with the patient in three successive positions: Lying down, semireclining and standing up. These changes give opportunity of detecting the mobility of loose kidneys as well as outlining the shape and size of the organs, and eliciting any tenderness that may be present.

#### BIBLIOGRAPHY.

1. Guiteras: *Urology*, i.
2. Kümmel: *Trans. 32d Congress of German Surg. Soc.*
3. Lewis: *Ann. Surg.*, March, 1915.
4. Lewis: *Keen's Surg.*, iv, 300.
5. Lewis: *Trans. Am. Assn. of Genito-Urin. Surg.*, 1893.
6. Lewis and Mark: *Cystoscopy and Urethroscopy*, 1915.
7. Schmidt and Kretchmer: *Trans. Am. Urolog. Assn.*, 1911, p. 233.
8. Schwarz and McNeil: *Am. Jour. Med. Sc.*, May, 1911.
9. Thomas: *Jour. Am. Med. Assn.*, November 28, 1914.

## CHAPTER IV.

### THE ROENTGENOLOGY OF THE URINARY TRACT.

By WALTER J. DODD, M.D.

IN order to make a successful examination of the urinary tract, certain conditions are necessary. The patient must be prepared and the proper technic used. It is absolutely essential that a distinct outline of both kidneys should be seen and the entire course of the ureter and bladder must also be examined. It has been stated that a good *x*-ray plate must show the transverse processes of the lumbar vertebra, the eleventh and twelfth ribs and outline of the psoas muscle. Some years ago, roentgenologists had to be content with the above, but today there is no reason why a distinct outline of both kidneys cannot be clearly revealed, even in stout individuals.

**Preparation of Patient.**—When possible, the patient should be given a good cathartic, preferably a sufficient dose of castor oil, and for twenty-four hours preceding the examinations liquids without solids should be the diet. Enemata should be given only in emergencies, owing to the fact that particularly if there is much delay before the examination is made, the intestines are apt to become distended with gas and the kidney outlines may be obliterated. Calomel or preparation containing heavy metallic salts should not be used as a cathartic.

The above conditions we realize are ideal and frequently cannot be followed. In fact, hundreds of cases are examined every year in a large out-patient clinic and the known error is still only 5 per cent.

It would seem from this that, if a thorough technic on the part of the roentgenologists is complied with, the Roentgen examination of the urinary tract for the detection of urinary calculi must be considered extremely successful.

Under ideal conditions, roentgenologists agree that probably 2 per cent. would be an excusable error. We must remember that there are certain types of renal calculi, fortunately extremely rare, such as xanthin, cystin, and pure uric acid calculi, which are detected only with great difficulty. Pure uric acid calculi are rare in adults. Although many have been reported as being revealed by the Roentgen methods, if a perfect chemical analysis had been made of these stones, enough calcium salts would have been found present to explain the reason of their detection by this method.

**Sources of Error.**—It has been stated by various writers that the percentage of error in locating renal calculi varies from 5 to over 30 per cent. Five per cent. is almost an excusable error in a large out-patient clinic where the patients are not properly prepared and are

often apprehensive and many times cannot be made to understand the very essential point that they must hold their breath during the exposure.

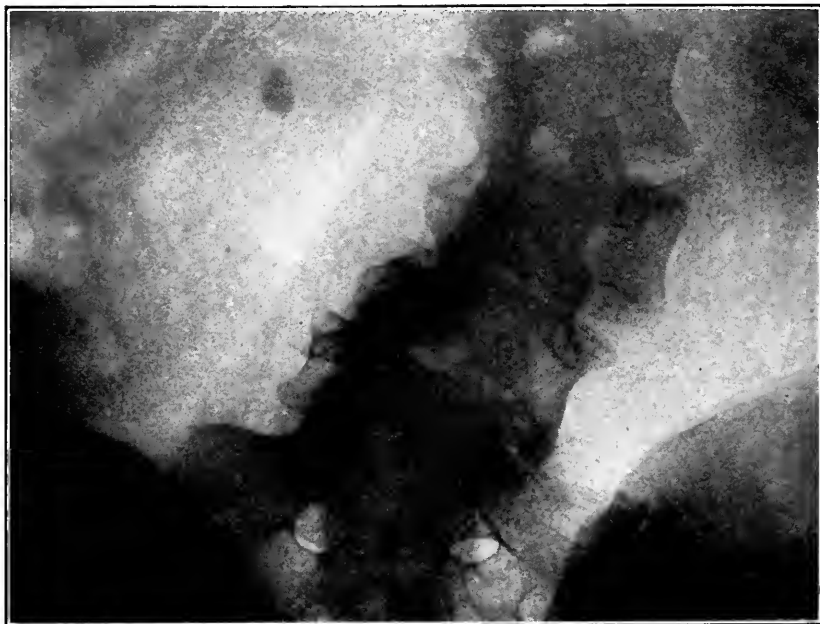


FIG. 92.—Patient sent in for examination of spine. Old Pott's disease. Plate reveals stone in kidney. This plate shows the great importance of not only examining spine in such cases, but also the renal area. It is also wise to examine spine when making renal examination, as not infrequently pathological processes may be revealed in the spine.



FIG. 93.—Stone in the pelvis of the kidney. No symptoms. Patient sent in for other examination. X-ray examination of kidney made owing to presence of pus in urine.

Very frequently calcified glands are present. Sometimes singly and, in other cases, numerous glands are seen. As a rule, it is easy to



FIG. 94.—Shadows seen over fifth lumbar transverse process proved by radiographic catheter to be calcified glands.

distinguish between calcified glands and renal calculi. The writer has found that the best method to differentiate these shadows from calculi was to take separate plates, one in forced inspiration and the other in



FIG. 95.—Radiographic catheter proves that shadow seen over fifth lumbar transverse process is not in ureter.

forced expiration. Usually it will be seen that the shadow does not bear the same relation to the kidney in these two plates, as the kidney

probably moves to a much less degree than the glands. Stereoscopic plates are also of great value in such cases.

**Pigmented Moles.**—Pigmented moles on the back of the patient, which sometimes lie in the course of the ureter or in the renal area, may also be mistaken for calculi. Here, again, stereoscopic plates would be of greatest value, or if a wire ring is put around the mole and a piece of adhesive plaster fastened over the ring on the skin, it will be seen that the shadow changes its position. When the adhesive strap is pulled to one side, its relation to the transverse processes of the lumbar vertebra may be changed considerably.

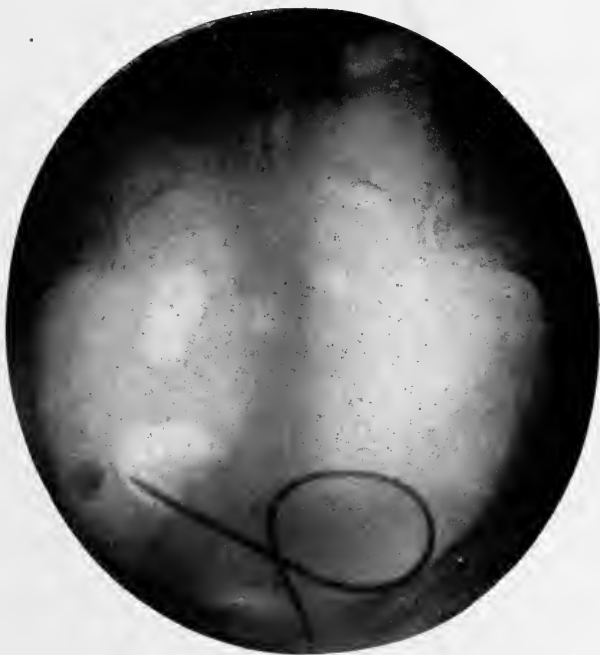


FIG. 96.—Large phlebolith adherent to the ureter causing symptoms.  
(Case of Dr. Lincoln Dodge.)

**Concretions in the Appendix.**—These may be mistaken for ureteral calculi, particularly following a bismuth meal.

**Osteophytes.**—Osteophytes of the transverse processes of the lumbar vertebrae not infrequently look like small, round ureteral calculi, but ureteral catheters impervious to the x-rays and stereoscopic plates will enable one to readily differentiate this shadow from a calculus.

**Phleboliths.**—Phleboliths which are so frequently found in the large veins of the pelvis, and oftentimes lie right in the course of the ureter, can invariably be distinguished by means of the ureteral catheter and stereoscopic plates.

**Intestine Shadows.**—Intestine shadows, as a rule, can be readily recognized, but not infrequently small masses of bismuth, following a

bismuth meal, may lie in the renal area or in the course of the ureter. As a rule, however, these shadows are of such a nature that this need



FIG. 97.—Numerous stones in right kidney. Might be mistaken for gall-stones. One large stone in left.

not be considered a serious source of error. Calomel tablets or other pills or tablets containing heavy metal salts may give rise to mistakes.

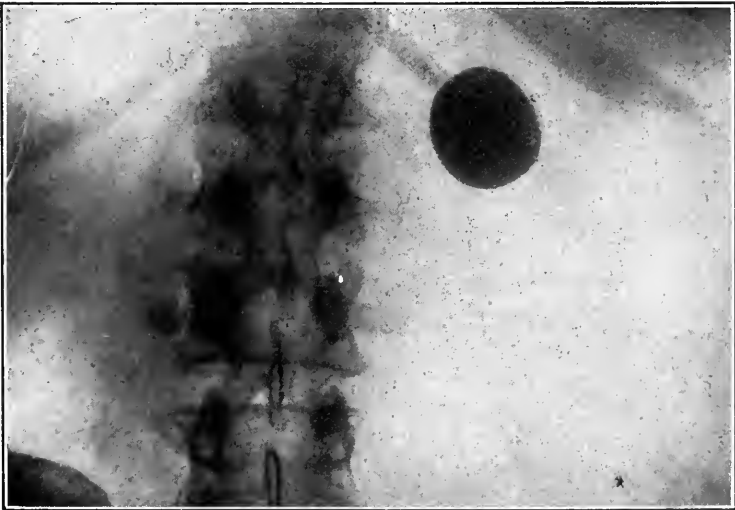


FIG. 98.—Same case after removal of stones from right kidney.

**Gall-stones.**—Gall-stones not infrequently closely resemble renal calculi and may lie in the renal area. As a rule the shadow changes its

relation in full inspiration and forced expiration more than the kidney outline changes. The best way to differentiate gall-stones from renal stones, however, is to take a plate of the patient in the prone position as well as in the supine position. In the prone position the shadows will appear much clearer than when in the supine position.

**Technic.**—We have seen that a good Roentgen plate of the urinary tract must show the outline of both kidneys, as well as the transverse processes of the lumbar vertebræ, psoas muscle, and the eleventh and twelfth ribs, and that part of the bones of the pelvis, *i. e.*, sacrum and ilium, which the ureter crosses. In order to obtain such a plate, certain points of technic must be observed, and as already stated, if possible, the patient should be properly prepared.



FIG. 99.—Multiple renal calculi in boy, aged eleven years.

For a number of years the writer has used a pure rubber bag covered with canvas in order to get the necessary compression. Some form of compression must be used. The compression cylinder is extremely valuable, but he has found the rubber bag, first suggested by Caldwell, far superior. The compression when applied by this means is more bearable to the patient and is more uniform. Small compression cylinders can be used and separate plates taken of each kidney: one of the middle portion of the ureter and another plate of the lower portion of the ureter and bladder. He has found, however, that both kidney outlines can be distinctly seen on one plate when the proper compression is applied with the inflated rubber bag, and that another plate

taken of the lower portion of the ureter and bladder will give the entire urinary tract.

Thus it is necessary to take only three plates: two of the renal area, one in forced expiration and one in forced inspiration, and another one of the bladder and the lower portion of the ureter.

After the plate is properly under the patient, making sure that the top of the plate is at least as high as the tenth rib and the lower edge of the plate is just below the crest of the ilium, the tube is carefully focussed in the median line; the compression bag or cylinder is then placed on the abdomen; the patient is requested to take a long breath



FIG. 100.—Illustrating position of patient when taking plate of kidney. Notice that the shoulders and legs are elevated and that the back is flat on plate. Patient's arm elevated to show plate. Should be at the side when plate is taken.

and slight compression is applied. The cylinder or bag will thus be forced down slightly under the costal margin and the focal point of the tube will be practically between the ensiform and the umbilicus. The patient is requested to take another full breath and then forcibly exhale it. When the lungs are completely empty, full compression is applied. The tube is locked in place after being tilted upward about 5 degrees so that the central rays cut upward, thus enabling one to get a picture of the upper portion as well as the rest of the kidney outline. The legs are flexed in order to correct the lordosis which is so commonly present, thus bringing the back of the patient close to the

plate. When necessary, the shoulders are elevated. The elevation of the shoulders and flexion of the legs should, of course, be done before compression is applied.

After these essentials are complied with, it is only necessary to make the exposure, but the patient should be instructed not to breath during the exposure and to keep perfectly still. The length of the exposure varies from a fraction of a second to two seconds, according to the size of the patient. After this exposure has been made, another plate is taken in forced inspiration. The third plate of the lower portion of the ureter and bladder is now taken. Compression



FIG. 101.—Position of tube when plate of bladder and lower portion of ureter is taken.

cylinder with the rubber bag can be used. The focal point for this plate should be exactly in the median line of the body and the central rays should pass through a point just below the anterior superior spine, but always in the median line. This will give us that portion of the bony pelvis and the sacral synchondrosis over which the ureter passes, as well as the bladder. The tube should be tilted about 10 degrees. Not infrequently ureteral stones lie in the ureter as it crosses the sacrum and may lie right at the brim of the pelvis. A good plate will usually show these calculi even without tilting the tube, but if the stone is not sufficiently dense, it may be overlooked unless the tube is tilted.

Stones near the brim of the pelvis with this technic will be thrown off the bony structures and the shadows appear in the true pelvis.

**Pyelography.**—This term has been applied to that part of roentgenography in which the pelvis of the kidney and ureter is made apparent on the plates by injecting into the renal pelvis some solution that is opaque to the  $x$ -rays, such as collargol, solution of thorium nitrate or a suspension of argentide. The writer has found the argentide suspension very satisfactory and not so irritating as a collargol solution.

This method is of extreme importance in some cases, for when the renal pelvis is properly injected, abnormalities in contour as well as size can be quite readily determined.



FIG. 102.—Collargol injection showing evidence of renal tumor. Pelvis large and distorted. Kidney lower than normal.

**Uric Acid Stones.**—Another valuable use of this method is in cases where clinical evidence points very positively to the presence of a stone and the stone has not been revealed on the  $x$ -ray plate, the injection of an opaque solution will frequently coat the stone which by the ordinary method was invisible. The writer believes that when such stones are revealed by this method, that they are probably pure uric acid or stones that do not contain sufficient lime to demonstrate their presence.

**Nephroptosis.**—Another use for the opaque solution is to determine whether the patient has a very freely movable kidney. This is best determined by taking the regular compression picture and then without shifting the position of the tube in relation to the patient, simply withdraw the original plate, insert a fresh one, and then tip the table into the upright position; an exposure being made, of course, in this position.

This technic requires a special table and it is better to use one in

which the tube is under the table and moves with the table as it is tipped. This requires that the patient be in the prone position instead of in the supine position. This is an extremely valuable method and



FIG. 103.—Collargol injection showing kink in ureter.



FIG. 104.—Stone in ureter.



FIG. 105.—Large stone in ureter. Removed by Dr. Horace Binney.



FIG. 106.—Ureteral calculi—one at vesicle orifice and one just above the bladder.



FIG. 107.—Same case eighteen hours later. Very important, as this case shows, the great necessity of making the examination as near the time of operation as possible, as the stones may change their position.

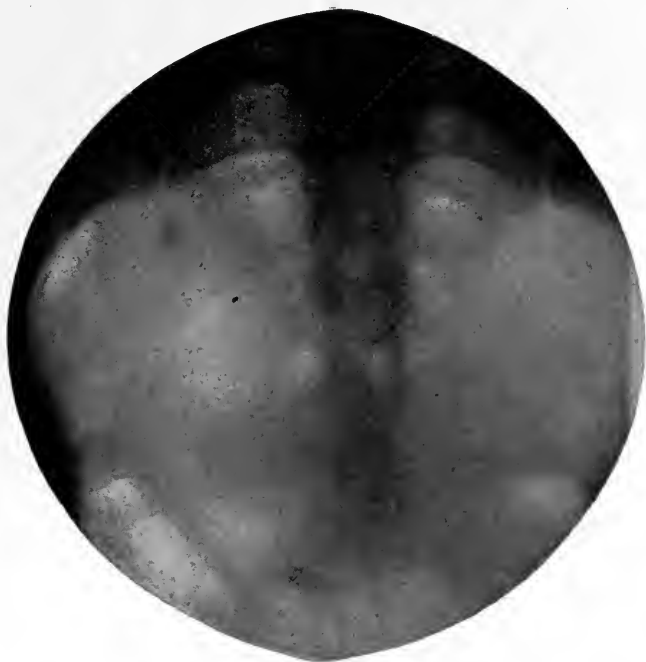


FIG. 108.—Stone in left ureter appears just below brim of pelvis. Was not revealed in original plate which was not clear enough to differentiate the stone from the bony structures.

fluoroscopy can be combined with roentgenography in such cases with such a table.

**Ureteral Calculi.**—The use of the opaque solution in determining the presence of ureteral calculi is also of value. When the roentgenologist makes the diagnosis of a stone in the ureter or when the diagnosis is doubtful owing to the presence of phleboliths or calcified glands or shadows in the region of the appendix, this method will frequently give confirmatory evidence. It is not at all uncommon for the catheter to pass freely through the entire course of the ureter without obstruction even when a stone is present, as the ureter may be greatly dilated.



FIG. 109.—Large prostatic calculus weighing 60 grams.

When the opaque solution is injected, the stone, as a rule, will be surrounded by the collargol shadow. The opaque solution also is of great use in revealing kinks and tortuosities of the ureter.

**Prostatic Calculi.**—The same technic is used as was described for stones in the lower portion of the ureter and bladder. That is, the tube is tilted from 5 to 10 degrees, the focus of the tube being in the median line, midway between the symphysis and the anterior superior spine. This will throw the symphysis off the field and prostatic calculi may be revealed providing they contain sufficient lime salts.

**Diverticula.**—Another use for the opaque solution is in demonstrating diverticula of the bladder. The writer has found the best method to be the following: About one ounce of a 20 per cent. solution of collargol is injected into the bladder and allowed to remain for a few minutes. The bladder is then evacuated and in most cases the diverticuli will retain sufficient solution to be well defined on the plates.

**Stone in the Bladder.**—Most stones in the bladder can be readily revealed, but soft phosphatic stones are not infrequently missed. If the bladder is distended, a distinct outline can usually be seen, but the stone itself may appear very faint. In such cases it is wise to have the bladder evacuated and take another plate. Not only will the stone appear more distinct but not infrequently its position will have changed.

Faint shadows often appear in the region of the bladder and these shadows are usually due to intestinal contents. Calcification in the walls of the uterus may resemble a stone, also calcification of the ovary. As a rule these sources of error can be readily eliminated. The intestinal contents can be eliminated by means of an enema and the shadows in the uterus and ovaries by palpation.

**Exposure.**—The length of the exposure depends upon two factors: the power of the machine and the size of the patient. In such an article as this it is unnecessary to go into details regarding apparatus. It is only necessary to say that with the modern transformer, so-called interrupterless machines, the exposure varies from one-half second to four seconds, according to the size of the patient. The penetration of the tube should be equivalent to 6 or 7 degrees on the Benoit penetrometer.

**Dark-room Technic.**—Absolute cleanliness in the dark-room is essential and nothing should come in contact with the film of the plate. The author has found the tank system of developing the ideal method. The formulæ for developing and the fixing solutions are usually furnished by the plate manufacturer, any of which are perfectly satisfactory.

A normal plate will be developed in from six to ten minutes. It should be thoroughly washed in running water before being placed in the fixing bath. It is wise, as a rule, to leave the plate in the fixing bath for about fifteen minutes after all signs of unaffected silver salts have disappeared. Otherwise the plates will slowly become blackened and the image almost disappear. The plates should, of course, be thoroughly washed in running water for about one-half hour and interpreted when dry.

## CHAPTER V.

### SYPHILIS OF THE GENITO-URINARY ORGANS.

By B. C. CORBUS, M.D.

#### SYPHILIS OF THE URETHRA.

THE *Spirochæta pallida* may invade the urethra in either the primary, secondary, or tertiary periods, and provoke lesions which on account of their site, form, and evolution may produce a variety of more or less obscure symptoms.

In 1897 appeared the first review of syphilis of the urethra, by Faitout,<sup>5</sup> followed later (1898) by the thesis of Bellet,<sup>22</sup> and still later (1905) by the general review of "Syphilis of the Urethra," by Simionescu.<sup>15</sup> More recently (1908) the thesis of Rougier,<sup>14</sup> "Tertiary Syphilis of the Urethra," followed by the general review of "Syphilis of the Urethra," by Tanton,<sup>16</sup> have added materially to our knowledge of these conditions.

**Primary Syphilis.**—1. **Frequency.**—Fournier<sup>8</sup> reports that out of 414 indurated chancres, 32 occurring at the meatus, 17 were deep and could easily have escaped notice. In women urethral chancre is much more infrequent than in men. According to Fournier,<sup>7</sup> the order of frequency in women is as follows: Entrance to the vagina, region of the clitoris, uterine neck, and urethra.

2. **Location.**—Urethral chancre is located either at the meatus (chancre of the meatus) or more deeply in the interior of the urethral canal (endo-urethral chancre).

A. CHANCRE OF THE MEATUS.—Chancre of the meatus may make its appearance in the following ways:

1. Round chancre embraces all of the free extremity of the canal. This form presents itself under the aspect of a small rose-colored circle, hemming in the meatus and leaving the urethra projecting like a beak on the surface of the glans.

2. Left or right hemilateral chancre occupies the corresponding lip of the meatus; it appears under the form of a projecting nodule which provokes a deformation of the meatus by retraction of the corresponding lip or side on which the chancre is located.

3. Superior or inferior commissural chancre occurs in the form of a crescent, the corners of which descend or ascend more or less on either of the two lips of the meatus or on both.

These three types of chancre during the course of their evolution may lose the primitive characteristics which differentiate them from each other, particularly when phagedena is a complication.

*Symptoms.*—Syphilitic chancre of the meatus may be of either erosive or ulcerative type. Induration is marked and often diffuses toward neighboring structures.

When the chancre is situated exactly on the meatus, whether or not it extends itself into the canal, the orifice presents itself as swollen, deformed, red and gaping, bleeding on pressure and offering to the touch a sharply circumscribed, indurated area.

In women, syphilitic chancre of the meatus usually has its site at the inferior angle of the orifice. Simionescu<sup>15</sup> cites an observation where the chancre, primarily located at the meatus, sank into the urethra up to the vesical neck.

**B. ENDO-URETHRAL CHANCRE.**—While endo-urethral chancre is not common, it is far from uncommon. Occurring in the fossa navicularis portion of the urethra, as it does, many times it is unrecognized. Often it is so near the meatus that it can be seen by forcibly separating the borders of the urethral orifice. Du Castel<sup>4</sup> observed one situated 2 cm. behind the fossa navicularis. Fasoli<sup>6</sup> cites one situated  $2\frac{1}{2}$  cm. from the meatus on the inferior wall of the urethra.

Endo-urethral chancre occurs in the following ways:

1. From a chancre at the meatus, extending by continuity. The endo-urethral chancre of the anterior portion of the urethra is only an extension of the chancre of the meatus.

2. Sometimes, in patients afflicted with gonorrhea, the mucous membrane in the fossa navicularis becomes eroded, producing an atrium of entrance for the spirochetes.

3. It is possible, but highly improbable, that infection may take place by the passage of sounds into the urethra. Such things have been reported, but in this day of asepsis and antisepsis, it is almost beyond belief.

*Symptoms.*—The three principal symptoms are:

1. Pain.
2. Discharge.
3. Induration.

1. *Pain.*—This is slight, always accompanies micturition and occurs in the majority of cases toward the end of urination; this is due to the expansion and contraction of the base of the lesion.

2. *Discharge.*—This is the first symptom noticed by the patient and causes him to consult a physician. In every case a discharge is the initial symptom. It begins slowly after variable periods of incubation. In the beginning it is seldom accompanied by pain at the time of micturition; it is very watery at first, later slightly seropurulent, easily becoming blood-tinged, especially if the urethra is palpated roughly. At times the discharge is thick and purulent, but this is always a sign of mixed infection.

3. *Induration.*—This is perceptible only by palpating the glans from behind and in front; the chancre is situated in the substance of the urethra, following an anterior-posterior direction, and, as a consequence, is lamellate in form. Often in the fossa navicularis the induration

manifests itself as a mass of cartilaginous consistency and of variable dimensions.

In women the endo-urethral chancre is situated in the anterior part of the canal; in order to locate the induration, the index finger of the left hand is introduced into the vagina in contact with the suburethral region, while the right index finger examines the meatus from before backward. Sometimes this forms a veritable indurated cylinder, a peri-urethral muff, around the canal. At other times it is limited to the inferior segment of the canal and to the lateral surfaces.

Syphilitic chancre of the urethra is accompanied by indolent inguinal adenitis, the same as any other chancre situated on the penis; at times the dorsal lymphatic vessels appear as an indurated cord.

**Diagnosis.**—Chancre of the meatus should not be difficult of diagnosis from the character of the induration, appearance, and lastly and most important, from the microscopic examination of the secretion for *Spirochæta pallida*.

In endo-urethral chancre, most patients present themselves on account of a discharge; this should be immediately examined for gonococci, as this is the most frequent condition that produces a "urethral running." Failure to find any organism either of a specific or non-specific variety should arouse suspicion.

Chancre of the meatus may be confounded with simple chancroid of the meatus, on account of induration caused by the irritating effect of the urine; however, in chancroid there is more discharge and extreme pain, and the lesion may be covered by a membrane with a dirty, moth-eaten appearance.

Superficial erosions due to gonorrhea may simulate chancre of the meatus, or both may exist together.

Herpetic eruptions are multiple, the borders are polycyclic, and, if recent (vesicle stage), clear serum can be expressed from the lesion.

Syphilitic chancre of the meatus may be confounded with epithelioma of the glans; here an error in diagnosis might lead to unnecessary operation. The epithelioma may be accompanied by infiltration and adenopathy, the same as a chancre.

In women the error may be still more easy, as the periphery of the meatus is the place of election of urethral epithelioma; cancerous induration is more extended, but less hard and less resistant than the syphilitic induration. The adenopathy is less tardy in the neoplasm, and the neoplasm does not tend toward cicatrization.

However, in all cases a careful history should be noted, together with a complete physical and careful microscopic examination. In examining for *Spirochæta pallida* there is no better way of obtaining the material than by capillary attraction, as illustrated on page 251, under Genital Ulcers.

**Complications.**—The evolution of urethral chancre is slower than that of other syphilitic chancres; this is due, in a measure, to the constant passage of urine and secondary infection, with poor drainage.

*Ulceration.*—Often in the male and female, syphilitic chancres of the meatus may form extensive ulcerations, the edges become uneven, the base grayish, and a pseudomembrane may form, giving the condition, as a whole, a formidable appearance.

*Phagedena.*—Occasionally, in practice, more especially in dispensary work, chancre of the meatus is seen complicated by phagedena. This condition, occurring in endo-urethral lesions, is not so common. When occurring at the meatus, it may form extensive cavities, extending deeply; it may even decapitate the glans penis or enlarge the meatus considerably. Extensive mutilation may later cause complete closure of the orifice, calling for surgical interference.

*Stricture.*—Chancre of the meatus or endo-urethral chancre may at times cause stricture. Two varieties may occur:

1. A diminution of the caliber due to the syphilomatous neoplasm.
2. True cicatricial stenosis.

The first variety occurs at the time of the specific induration and is of little importance; the stenosis disappears with the reabsorption of the induration.

The second variety follows ulcerated or phagedenic chancres, especially of the meatus and fossa navicularis. These strictures follow the general law of cicatricial strictures. They develop with great rapidity and offer great resistance to dilatation.

**Secondary Syphilis.**—**Urethral Mucous Syphilides.**—Numerous French authors recognize the possible existence of a specific secondary urethritis. It is characterized by a more or less viscous, transparent, slightly opalescent discharge, rarely creamy or purulent. This is scarcely perceptible during the day, but is always present in the morning, after the urine has been held all night. Inflammatory symptoms are absent. Microscopic examination without the dark-field condenser shows nothing characteristic; mucus and epithelial cells predominate. However, the *Spirochæta pallida* may be found if the proper apparatus is used. Antisyphilitic treatment rapidly clears up the condition.

It is this secondary specific urethritis that is the means of contagion through the semen, which, during this period, in its passage through the urethra at the time of ejaculation becomes saturated with the urethral discharge and the spirochetes that it contains, thus acting as a carrier of the infection.

An interesting case of Rochon is cited by Tanton,<sup>13</sup> the details of which are as follows: A woman presented on the abdomen excoriations caused by her corset; the syphilitic husband, afraid of having syphilitic children, had the habit of ejaculating on the abdomen. A gigantic chancre developed at the site of the excoriations. The author concluded that urethral mucous syphilides existed.

**Tertiary Syphilis.**—In 1901 Fournier<sup>8</sup> reported nineteen cases of tertiary syphilis of the urethra; Mauriac,<sup>11</sup> Gaucher,<sup>10</sup> Renault,<sup>12</sup> and Rougier<sup>14</sup> have observed and reported cases; recently Drs. Dey and Kirby-Smith<sup>3</sup> in this country have reported two interesting cases.

**Time of Appearance.**—Often they are late, making their appearance eight, ten, or even fifteen to twenty years after the primary symptoms.

**Modes of Invasion.**—1. *Primary.*—These lesions make their appearance by way of the canal.

2. *Secondary.*—These lesions appear in the canal from an extension by continuity.

In the case of primary localization these lesions may appear under two forms.

(a) Primary ulceration.

(b) Syphilitic gumma.

The latter is the most common form and may be presented under two clinical aspects:

1. Circumscribed infiltration.

2. Diffuse infiltration.

Circumscribed infiltration appears as a small gummatous tumor, often resembling a small tumor or core, forming a slightly rounded or hemispherical projecture.

In the diffuse infiltration the gumma grows on the surface, infiltrating the tissues to a variable extent, often appearing as a sheet-like induration.

Both of these forms may contract the canal, causing symptoms of obstruction in a greater or less degree. However, these forms often undergo softening and ulceration, thereby eliminating, for the time being, obstructive symptoms. Hemorrhage following such a condition may be severe.

These gummata may break down and ulcerate in either one of two ways: toward the urethral canal or on the under surface. If the gumma breaks down on the surface which is in connection with the urethral canal, it often forms internal blind fistulæ which act as reservoirs and collect urine during the act of micturition. Later, these foci may be the starting-points of urinary infiltration and abscess.

**Symptoms.**—Tertiary syphilitic lesions of the urethra have the following characteristics:

1. Insidious invasion, indolent, often remaining for a long time unnoticed.

2. Slow evolution: It is necessary for these lesions to attain comparatively large proportions before the patient seeks surgical advice.

3. The local reaction is generally insignificant or absent. There is no inguinal adenopathy.

In general, these lesions do not pass the balanitic region, for which they seem to have a specially marked predilection.

**Cylindroid Syphiloma of the Urethra.**—Cylindroid syphiloma is a gummatous infiltration, regular, cylindric, occurs in a segment of the canal and may lead to stricture. It occurs under two forms:

(a) Sclerotic.

(b) Sclerogummatous.

The sclerotic form is rare, severe, and resistant to treatment.

The sclerogummatous form is benign and yields rapidly to specific treatment; the gummata disappear, the islands alone persisting. This



FIG. 110.—Extensive gummatous destruction of the glans penis involving the urethra. Date of primary infection three years. Wassermann positive. Neglected treatment. One salvarsan injection made in May, 1911. (Author's case.)



FIG. 111.—Beginning gumma of the glans penis involving the urethra. Previous treatment none. Wassermann positive. (Author's case.)

condition may exist at the same time as other gummatous lesions of the canal, from which it seems only a prolongation.

**Complications following Tertiary Urethral Syphilis.**—*Phagedena*.—Phagedenism, according to Fournier, is the most serious and gravest complication that can occur. He says that one should be impressed with the fact that genital phagedenism occurs as a complication in tertiary syphilitic lesions more frequently than in simple chancres. Here phagedena of the urethra may destroy not only the meatus, but also may extend extensively into the glans portion of the urethra. This is particularly noticeable inferiorly where gummata are most often encountered. From this extensive destruction hypospadias of the glans portion may occur to a greater or less degree.

*Fistula*.—As a result of this extensive destruction, fistulas are very frequent. They may be in the following locations: fistulas of the balanopreputial groove, of the fossa navicularis, or of the body of the penis, causing destruction of the penile portion of the urethra to a greater or less extent.

Albarran<sup>1</sup> says: "It is probable that certain fistulas are veritable urinary abscesses with secondary infection, the microorganisms gaining entrance into the lesions through the canal, thus acting as a great open portal for entrance into peri-urethral tissue."

*Stricture*.—Strictures may be of two kinds, false or pseudostriictures, and true strictures.

False strictures occur during the formation of the gumma and, once they ulcerate or dissolve, empty their contents either into the urethra or externally, and the stricture disappears.

True or cicatricial strictures occur secondary to ulcerated urethral gummata or following phagedenic ulceration, or as a sequel to cylindroid syphiloma.

The site of the obstruction depends on the form of syphiloma from which it is derived. It is most frequently found at the meatus or in the balanitic region.

The diagnosis of this form of stricture must be made on the particular history of the patient. Diagnosis may be considered under the following headings: Wassermann reaction, microscopic examination of the discharge, and a careful physical examination.

The Wassermann reaction here, as in other forms of tertiary syphilis, if performed by a careful serologist, should be positive in 100 per cent. The urethral discharge is very characteristic. The diagnosis is made by exclusion. If one cannot find any predominating organism, one should be suspicious and a careful search continued until the diagnosis is positive.

Erosive and gangrenous balanitis may produce destructive symptoms at times, greatly simulating a broken-down gumma; however, microscopic examination will rapidly settle the question.

Epithelioma, while comparatively rare, must be thought of. Glandular enlargement, however, occurs early. Gummata here, as elsewhere, grow very slowly and ulcerate only after some time. They are only slightly painful, and, as a rule, are attended by no constitutional symptoms; however, both gumma and neoplasm have the common

characteristic of being indurated. The cancerous discharge is purulent, foul-smelling, often streaked with blood and the pain at micturition is severe. If the urethra is explored with a sound or bougie there is abundant bleeding. Often the sound will bring away particles of the tumor. These should be microscopically examined immediately. Neoplastic induration often adheres to the deeper parts, ulcerates the skin and produces fistula surrounded by neoplastic offshoots.

In the neoplasm the edges of the ulceration are projective, thick and resistant; the surface bleeds easily, with a characteristic fetid discharge.

In syphilitic gumma there is no adherence to subjacent parts, the base is unequal, and if seen early, there often exists a yellowish adherent scab with central necrosis. The base is indurated but not painful; secretion is not marked. The Wassermann reaction is always negative in epithelioma, and a biopsy will rapidly clear up the diagnosis.

Occasionally urinary abscess may be mistaken for gumma. Here the history either of traumatism or of previous stricture should be sufficient to make the picture plain.

**Prognosis.**—The prognosis of primary lesions, whether occurring at the meatus or endo-urethrally, depends on a prompt diagnosis. If treatment is begun early, before there is any secondary infection and destruction, these lesions cause no further symptoms.

However, in tertiary syphiloma the prognosis varies according to the character of the lesion. In simple, uncomplicated cases, ulcerations scar over rapidly and gummata dissolve. But if there is great destruction of tissue, with resulting strictures, treatment may be prolonged and unsatisfactory.

**Treatment.**—In chancre of the meatus and endo-urethral chancre the treatment is the same as described under primary lesions elsewhere. (See Chapter VIII, p. 257, under Genital Ulcers.)

In tertiary lesions of the urethra the treatment is the same as that described under Tertiary Lesions of the Bladder.

For the treatment of stricture following tertiary lesions of the meatus and urethra the reader is referred to the chapter on Strictures.

### SYPHILIS OF THE PROSTATE.

The small number of reports in the literature up to the present would seem to indicate that syphilis of the prostate is extremely rare. Unlike the bladder, infections in the prostate only manifest themselves in the destructive lesions of tertiary syphilis. In this condition a reliable Wassermann report is the best aid in diagnosis.

When we stop to consider that syphilitic infection can occur in any part of the human organism, it is only natural to suppose that now and again it would involve the prostate. Consequently, if we hope to recognize this condition in the future, it will be necessary carefully to examine all cases that are at all typical for prostatic involvement.

Among the cases in the literature heretofore published are one by M. Drobney<sup>17</sup> (1906), another by F. R. Wright<sup>19</sup> (1912), and a third by

J. O. Rush<sup>18</sup> (1913). A study of the symptoms in these cases shows that it is extremely difficult to diagnose this infection from hypertrophy of the prostate, as they both occur in the later period of life and are attended by the same symptoms.

### SYPHILIS OF THE BLADDER.

By syphilis of the bladder is meant only those diseases which involve the bladder mucous membrane itself. All those affections which extend from the surrounding tissues to the bladder, whether they come from syphilis of the rectum in man or syphilis of the uterus and vagina in woman, are not considered.

Syphilitic lesions of the bladder are at present scarcely known and most of the works on urology and syphilology fail to make mention of the subject.

However, observations are being published and numerous articles have appeared in the foreign literature describing the clinical picture in detail, so that now that attention has been brought to this subject, it is highly probable that numerous cases will be reported in the future. The history of this affection is divided into three distinct periods:

In the first period there is almost complete obscurity. There is cited only an occasional observation of autopsy findings in syphilitics, dying on account of their urinary lesions, ulcers, perforations and tumors, which were discovered on opening the bladders. This extends down to the year 1872, at which time Tarnowsky<sup>41</sup> reported a case which is described later on in this chapter.

In the second period are related some clinical observations, the diagnosis being based solely on the result of treatment; some of these observations lack accuracy.

However, a sign of our advance in understanding this condition is the fact that the cases published during the second period were all diagnosed in life and many of the patients recovered under specific treatment.

In the third period diagnosis was made by the cystoscope, with the addition, many times, of the Wassermann reaction.

#### FIRST PERIOD, FROM 1767 TO 1872.

During this period 9 cases of syphilis of the urinary bladder were reported; all diagnoses were made at the autopsy table. Of these 9 cases, 5 were undoubtedly gummata and 4 were secondary lesions. Following is a brief history of the vesical findings, arranged in chronological order:

Morgagni,<sup>33</sup> in 1767, at the autopsy of a patient who presented scars on the surface of the penis and syphilitic lesions of the tongue and epiglottis, found a bladder hollowed out by ulcerations, and made the diagnosis of syphilis of the bladder. This observation is especially of historic interest, but on authority is doubtful.

Follin,<sup>24</sup> in 1849, found in a woman with destructive lesions of the bony and soft palate and syphilitic lesions of the liver, the vesical mucous coat covered with twelve small tumors about the size of lentils, making slight projections, in appearance similar to vulvar syphilitic papules.

Ricord,<sup>40</sup> in 1851, reports 2 cases: The first of a patient, aged fifty-two years, without special antecedent history, who for two months presented a urethral discharge, which was very abundant, persisting, and a little painful. At the end of fifteen days a right epididymitis appeared, with hydrocele; a month afterward the discharge was still very abundant and tinged with blood; the hydrocele had disappeared; the epididymis was still indurated. Soon a left epididymitis with hydrocele manifested itself. Then, in spite of the cure of the lesions, the discharge persisted, the general condition was aggravated, and death followed four months after the beginning of the infection. At the autopsy the membranous and prostatic portions of the urethra were hollowed out by deep ulcers, presenting the character of primary phagedena. The prostate was in part destroyed. In the bladder there existed several round ulcerations, with borders cut into peaks. On the left side the seminal vesicle, the vas deferens, and even the testicle, showed abscesses. On the right side these organs were normal.

The next observation dealt with a young man, aged eighteen years, who some days after a suspicious coitus had contracted a chancre of the frenum which spread from place to place, encroaching on the meatus. A little later an abundant discharge appeared, with painful urination. A phimosis formed, the constriction of which was removed by incision, but the edges of the wound ulcerated and the ulceration encroached on the glans and destroyed it almost completely. During three months the discharge persisted, with pain and incontinence of urine; death followed from marasmus. There was found at the autopsy an ulceration of the meatus which had encroached on the urethra, and a second ulceration much elongated on the surface of the membranous urethra and in the prostatic region. The vesical neck was in part destroyed. The vesical cavity was filled with elevated tumors, reposing on an ulcerated mucous coat; the vesical wall was hypertrophied.

Virchow,<sup>41</sup> in 1852, at autopsy found ulcerations of the bladder and urethra in a woman, aged fifty-four years, who for fifteen years presented periosteal pains and syphilitic ozena, with destruction of the nose and pharynx, and who, during the first month, had had incontinence of urine.

Vidal, of Cassis,<sup>42</sup> in 1853, reported the case of a patient, aged twenty-six years, who had had a chancre three years previously, and who, having presented urinary troubles, urethral discharge, abdominal pains, hematuria after micturition, and retention of urine, succumbed to a generalized peritonitis. At the autopsy there existed a vesicoperitoneal fistula. The vesical mucosa presented an elevated ulceration with edges cut into peaks, rounded, with a vascular periphery surrounded with disseminated plaques.

Tarnowsky,<sup>41</sup> in 1872, reports the case of a child, aged four years, infected by its foster-mother. The diagnosis of syphilis not having been made at the beginning, and the child having been treated for eczema, entered the hospital in a deplorable condition. The body was covered with oozing and ecchymotic papules. The mouth and throat were covered with ulcerations and mucous plaques separated by deep fissures. The general condition was not favorable. The respiration was difficult and anorexia complete. This child was subjected to mercurial treatment, baths and rubbings.

Four days after its entrance to the hospital it was noticed that at each micturition the child was extremely agitated and experienced pains in the genital region. On examination it was found that the prepuce was very much tumefied and inflamed, that the urethra was indurated and painful; puncture of the preputial sac allowed a purulent greenish-yellow liquid to escape. The patient died the twelfth day after his entrance to the hospital. At the autopsy the mucous coat of the urethra and, in part, that of the bladder were covered with superficial syphilitic ulcerations. The pharynx and throat were sprinkled with ulcerated papules; the liver was syphilitic.

Fenwick,<sup>23\*</sup> in 1879, reported the case of a twenty-three-year-old man who was admitted to the London Hospital for a stab wound; he died of the injury. Autopsy showed, beside this injury, a hard chancre of the penis and adenitis of the inguinal and lumbar glands. Elevated spots were seen on the mucous membrane of the bladder, which looked like condylomata.

Neumann,<sup>33†</sup> in 1899, reported a case of gumma of the bladder observed by him in a forty-four-year-old working woman, who presented in the bladder numerous round whitish nodules the size of a millet-seed, some of them isolated and some in groups.

#### SECOND PERIOD, FROM 1872 TO 1900.

Morris,<sup>34</sup> in 1897, reported the case of a woman who had bladder hemorrhage for months; she had lost thirty pounds in weight. Morris made a cystoscopic examination, but reports nothing definite; specific treatment caused a rapid subsidence of symptoms.

Griwzow,<sup>27</sup> in 1899, presented observations on two patients attended by urinary troubles of a doubtful nature; the diagnosis of syphilitic cystitis was admitted, because of the action of the mercurial treatment, which was instituted for the specific lesions in other organs.

In the first case, a woman, aged forty-two years, syphilitic for ten years, presented urinary troubles, pain, and intermittent retention of urine. The diagnosis of chronic catarrh of the bladder had been made, but the mercurial treatment instituted for three years gave no results. At this time, on palpation, a compact, rounded tumor could be felt

\* These authors' cases, while appearing in publications as cited, belong to the first period, 1767 to 1872.

† Ibid.

below the pubis, also palpable by the vagina; the diagnosis was not definite. At the same time the particular symptoms, pain in the region of the liver, with palpable hepatic nodes, diarrhea and vomiting, caused a diagnosis of gumma of the liver to be made, and in several months the mercurial treatment caused not only the hepatic symptoms to disappear but the vesical condition and the subpubic tumor as well.

The second observation by Griwzow is that of a man, aged thirty years, who had contracted syphilis six years before. The vesical symptoms and the pain on micturition, which he had for two years, persisted in spite of all local treatment. A perforation of the bony palate had appeared. Mercurial treatment was given, which brought about a cure not only of the soft palate, but also the disappearance of the vesical pains.

Griwzow had in these 2 cases discovered accidentally the specific nature of the vesical lesions.

Chezeltzer,<sup>22</sup> in 1901, presented a case similar to that of Griwzow. He treated a patient, afflicted with vesical pains and retention of urine for a long time, for catarrhal cystitis and prostatitis. He did not obtain any result, when, one day, he found the presence of syphilitic lesions of the testicle and psoriasis of the palms of the hands. Mercurial treatment brought about the cure of the testicular lesions and the disappearance of the vesical phenomena, which, indeed, seemed to have been of syphilitic nature.

Margouliès,<sup>30</sup> in 1902, reported a case of vesical phenomena, hematuria, incessant desire to urinate, diminution of vesical capacity, in a man, aged fifty-five years, a tabetic, who besides had a nephritis (albumin and edema). Margouliès made the diagnosis of syphilitic cystitis, and mercurial treatment caused the vesical symptoms to disappear. Unfortunately cystoscopic examination had not been made before treatment, and when made, it showed only a bladder rich in trabeculae, which occurs often in tabetics.

Towbien,<sup>42</sup> in 1904, reported a case, probably a gumma, the record of which, however, is incomplete.

### THIRD PERIOD, FROM 1900 TO 1916.

The rapid progress made, coincident with the development of the cystoscope, in the diagnosis of vesical lesions is particularly noticeable during this period; while the first authentic reports of Matzenauer<sup>31</sup> appeared in 1900, others were still using the older therapeutic diagnostic test and reporting their cases (Chezeltzer, Margouliès and Towbien).

It is interesting to note how, in the first years of the second decade (1872 to 1900), the syphilitic nature of the bladder infection was only occasionally discovered, and how later physicians came to consider the possibility of bladder syphilis more and more, and how, at last, Matzenauer,<sup>31</sup> in 1900, opened the modern period by publishing the first case of syphilitic ulcerations of the bladder, as observed by means of the

cystoscope. Since then the serum reaction of Wassermann has been added as strong supporting evidence in diagnosis.

Syphilitic lesions of the bladder may be of two kinds:

1. Secondary.
2. Tertiary.

**Secondary Bladder Syphilis.**—In 1893 Neumann called attention to the fact that secondary lesions of the bladder were undoubtedly not so rare as was previously thought.

Ernest Frank, in 1909, presented at the Congress of Urology in Berlin a number of plates of cystoscopic examinations of secondary lesions of the bladder before, during, and after treatment. In all he reported 5 cases that had never been published before. Unfortunately I have not been able to find a description of Frank's cases.

Paul Asch,<sup>20</sup> in 1911, reported the case of a woman, aged twenty-eight years, who presented all the signs of an acute cystitis which several doctors had diagnosed as gonorrhea. At the time of examination the patient urinated during the day every half-hour and at night every ten minutes. There was persistent and severe strangury, accompanied by terminal hematuria. Tuberculosis having been excluded by inoculation and microscopic tests, a cystoscopic examination was made which showed the following picture: The whole of the bladder mucous membrane was very much swollen and red, and scattered over it at irregular intervals were hard, superficial, round, and oval defects in the mucous membrane, with small undermined edges and whitish bases. They looked like syphilitic patches such as are found in the mouth in the secondary stages of syphilis. Examination of the inguinal glands showed them to be large, hard, and painless on both sides. The patient now admitted that one year and three months before, she had had a small ulcer on the left labium that had recovered under local treatment, and had not been followed by any other symptoms.

Mercury inunctions were ordered. During the first week of the treatment the symptoms seemed rather to increase, which was probably the result of irritation from the cystoscopic examination, but may also have been a reaction from the treatment itself. At the end of the second week the symptoms began to improve. The urine cleared up, the general condition improved, and in the fourth week the picture was very different. The patient had increased fourteen pounds in weight; she could retain her urine two to three hours in the day, and only had to get up once during the night. The urine was almost clear, containing only a few red blood cells and leukocytes. The cystoscope, at the end of the fourth week, showed the mucous membrane only a little reddened, with small white flecks of mucus. In the sixth week the bladder was completely normal, so that treatment could be given up. A year later the patient came for examination, and bladder and urine were both normal.

This case is undoubtedly one of those rare ones, not previously reported in the literature, of secondary syphilitic disease of the bladder corresponding to the patches in the mouth and sexual organs.

Pereschiwkin,<sup>37</sup> in 1911, published 3 cases of "papulous exanthema of the vesical mucous coat;" all these patients showed lesions on the skin and mucous surfaces, together with vesical symptoms.

In the first patient the cystoscopic examination showed a normal vesical mucous coat with the exception of the base of the bladder, which was edematous and hyperemic. On the periphery of the left ureter one saw several ulcerations with edges elevated and infiltrated. The base was very red, the ureteral orifices were normal.

In the second there existed in the region of the summit of the bladder seven small ulcerations with infiltrated edges.

In the third patient the vessels of the mucous coat were strongly injected and the vesical sphincter was edematous; on all the mucous coat, especially at the base of the bladder, there existed small areas of ulcerations of variable forms and dimensions, some with edges infiltrated, others with flat edges. The ureteral orifices were a little edematous. Mercurial treatment brought about a rapid disappearance of the symptoms. (Plate I, Figs. 1 and 2.)

Michailoff,<sup>32</sup> in 1912, published a case of a woman, aged thirty-nine years, who complained of bladder pain radiating into the hips; hematuria was periodic over a period of five years. Gradually the hematuria increased in amount and frequency. There were no pains during the hematuria, and the temperature was normal. The details of the cystoscopic picture were as follows: On the lateral and superior wall of the bladder, characteristic rows of vesicles covered by yellowish-gray crusts were visible; each vesicle was surrounded with small areas of the color of red raspberries which sharply contrasted with the normal coloring of the neighboring mucous coat. Here and there injected vessels were seen, the rows of circles, which were surrounded by little "coronas," looking like the papules which we are accustomed to see on the epidermis. Later on, at a second cystoscopic examination, catheterization showed that the hemorrhage came from the left kidney. In secondary affections of the bladder and upper urinary tract hemorrhage has never been observed. It is possible that the hemorrhage came from the renal papilla or from minute bloodvessels. It resembled that form of hemorrhage that is spoken of as "essential hematuria." The diagnosis in this case was based entirely on the cystoscopic examination, afterward confirmed by the Wassermann reaction, with prompt disappearance of local and general symptoms as a result of specific therapeutics.

Mucharinsky,<sup>35</sup> in 1912, reported the case of a patient who a year before had had a hard chancre; later roseola and treatment. There were no objective signs of syphilis; glands not palpable; no urethral discharge; there was painful urination by day and night; a catheter had been used for two weeks. Cystoscopic examination showed diffuse bluish-red hyperemia of the neck of the bladder and trigone; middle lobe of the prostate protruded considerably into the bladder; bladder tense; on the mucous membrane flakes of mucus; on the fundus of the bladder an ulcer the size of a copper coin, with jagged, strongly hyperemic

## PLATE I

FIG 1



FIG. 2



### Secondary Syphilis of the Bladder Mucous Membrane as described by Pereschiwkin.

Fig. 1 shows the vessels of the mucous coat strongly injected with some edema around the internal sphincter. All over the mucous membrane, especially on the base, are ulcerations of various forms and dimensions, some flat, others with infiltrated edges.

Fig. 2 shows complete disappearance after mercurial treatment.



edges; on the base of the ulcer a blood clot. Complete healing took place under specific treatment. This case belongs to the secondary erythemata of the bladder with ulcer formation.

The author has had the opportunity to examine cystoscopically one case of secondary syphilis in a young man with a diffuse macular eruption, without any bladder symptoms. The mucous membrane was diffusely hyperemic; the vessels were injected, with numerous islands of mucus adherent throughout. Urine from both kidneys showed a large number of leukocytes, but no organisms.

**Tertiary Bladder Syphilis.**—Matzenauer,<sup>31</sup> in 1900, heretofore mentioned as the first to publish a case of syphilitic lesion of the bladder ascertained by the cystoscope, describes a case of a girl, aged twenty-two, a syphilitic for four years, whose vesical neck was covered with papilloma-like projections resembling villousities; the rest of the mucous coat of the bladder was normal. On the superior wall of the urethra a superficial ulceration existed, with edges cut into peaks, reaching the internal orifice. Matzenauer made a diagnosis of gummata of the urethra and bladder.

MacGowan,<sup>29</sup> in 1901, reported a case of a patient, syphilitic for ten years, who presented urinary troubles and, in particular, vesical pains, with frequent desire to urinate and with retention of urine. The local treatment brought no amelioration; he made a cystoscopic examination. He found on the posterior part of the vesical mucous coat numerous papilloma-like projections and behind the right ureteral orifice several concentric ulcerations, with hard edges, infiltrated, the syphilitic nature of which could not be doubted.

While syphilis of the bladder is not so frequent in this country as it is abroad, and as a consequence not so easily diagnosed, MacGowan deserves credit for his pioneer report of a case diagnosed by means of the cystoscope.

Gräff,<sup>26</sup> in 1906, mentions a case in a fifty-six-year-old man, who, thirty-five years before, had had a gonorrhea and small ulcers on the penis, and who was admitted to the hospital because of repeated hemorrhages from the bladder. For some months there had been pain in the perineum and limbs, extending sometimes to the glans penis. Urination was difficult. Both testicles showed a moderate doughy swelling, but no pain. Catheterization was rendered difficult by a contracted external urethral orifice. Cystoscopy could not be performed on account of the bladder hemorrhage. The urine was bloody and purulent. No tubercle or other bacilli could be demonstrated in the urine. The general condition improved under irrigation of the bladder with weak silver nitrate solution and the hemorrhage and other symptoms decreased, so that the patient thought of leaving the hospital; cystoscopy was now possible and it showed, at the summit of the bladder, a tumor-like new growth with a defect in the centre and papillary proliferation of the edges, so that papilloma was suggested, or several small papillomata.

Suprapubic cystotomy was performed. At the summit of the bladder

there was an ulcer extending into the muscular layer, from the base of which white particles could easily be removed. The ulcer was cauterized, the bladder closed by suture, with drainage through a catheter. The wound healed unevenly. After opening the bladder, the nature of the tumor could be better recognized. In connection with the swelling of the testicle, it suggested syphilis. Syphilis had been thought of before, but the history alone did not give sufficient grounds for it. The diagnosis of gumma of the bladder and bilateral gummatous orchitis was confirmed by the results of the antisypilitic treatment, which was now begun. Six weeks after the operation the patient was discharged, completely cured.

The excised piece consisted chiefly of necrotic cell masses and bladder epithelium, which did not show any tumor-like degeneration.

Le Fur,<sup>23</sup> in 1902, reported the case of a patient who had never had gonorrhea, but eight years before had had syphilis, which was treated very irregularly. Two years before hematuria had appeared, which lasted throughout the act of urination. This occurred several times at irregular intervals, but without pain and without any other bladder symptoms. A few months before a more severe hematuria than usual had appeared, which caused urinary retention by the formation of clots in the bladder. The aspiration of these clots stopped the hemorrhage, but it must have been profuse, for the patient's mucous membrane was very pale. The urine was turbid, contained numerous red blood cells and leukocytes, but no bacteria. The capacity of the bladder was good. The prostate was very hard and irregular, and in the right lobe a large, hard nodule could be felt. The author suspected, therefore, that the hemorrhage was caused by chronic prostatitis and began treatment for that. As this treatment had no effect he made a cystoscopic examination.

He found a group of three ulcers in the region of the trigone, one of which was of some depth, had fissured edges and a gray base. From these findings he suspected an infection of the bladder from the diseased prostate and irrigated the bladder with a solution of silver nitrate. Since the urine remained turbid even after this treatment, and as syphilitic patches developed in the pharynx, the author concluded that syphilis was the cause of the bladder disease, and antisypilitic treatment brought about complete recovery in a short time. The urine became clear and free of blood, the prostate soft and the nodules disappeared. Cystoscopy showed white scars in place of the ulcers in the bladder.

Margouliès, in 1912, reported the case of a woman, aged forty-one years, who presented intermittent hematuria, with pains in the left hypochondriac region, radiating toward the bladder, with frequent desire to urinate; cystoscopic examination showed a little behind and to the left of the left ureteral orifice a neoplasm formed of three tumors, each the size of a bean; these three excrescences were very close to each other and the sides turned toward the summit of the bladder were covered with a visible membrane; all around the mucous coat was

hyperemic. Having made the diagnosis of cancer of the bladder, Margouliès, in proposing ablation, noticed that the patient bore on her legs whitish scars and had in her previous history a miscarriage. He had her take potassium iodide. To his great surprise it produced a rapid amelioration, and a month later the vesical tumors had disappeared, leaving on the mucous coat little insignificant scars.

Von Engelmann,<sup>45</sup> in 1911, reported the following 3 cases:

His first case was in a sixty-year-old woman who had had bladder hemorrhages for six months, without any other bladder symptoms. Cystoscopic examination showed, above the right ureter, a tumor about 3 cm. long, with ulcerated surface covered with a purulent membrane, and, in places, encrustation. The author thought the tumor was a carcinoma and proposed an operation; then he found that the patient had acquired syphilis twenty years before and ordered mercury treatment. The ulcerations healed rapidly and the entire tumor disappeared in a few weeks.

The second case was that of a man, aged forty-six years, who had suffered from hematuria at times during the preceding three months. He had had syphilis fifteen years before and a mercury and potassium iodide treatment. A year before paralysis of the left leg had developed, which disappeared after mercurial treatment. The urine was turbid, and at the end of urination there was slight pain. Cystoscopic examination showed, beneath the opening of the right ureter, a round, prominent tumor about the size of a hazel-nut, with surface partly ulcerated and covered with purulent membrane and with papillary characteristics in places. At that time there were no other syphilitic symptoms. The author made a diagnosis of gumma of the bladder and advised antisiphilitic treatment. Cystoscopic examination, after thirty mercurial inunctions, showed that the tumor had disappeared and there was a red spot in place of it. No local treatment had been given.

The third case was that of a woman, aged forty-seven years, who had had paralysis of both legs for a year. She had had painful urination for a month. There was a history of three abortions twenty years before. Examination showed syphilitic myelitis, ulcerated papules of the labia majora, swelling of the inguinal glands, paresis of the detrusor vesicæ and also of the extremities. The urine was turbid, contained much pus, streptococci, and Gram-positive diplococci; tubercle bacilli could not be demonstrated. Cystoscopy showed reddening of the bladder, and in the region of the opening of the left ureter, completely surrounding it, a large ulcer covered with encrustations which projected into the bladder. Similar encrusted ulcers were found in the summit, and on the lateral and anterior wall. They were all of different sizes, up to 5 cm. The encrustations could hardly be separated with the catheter; when separated, hemorrhages occurred. The surfaces of the ulcers were papillary in appearance.

Antisiphilitic treatment, combined with bladder irrigations, brought slow but progressive improvement in all the symptoms. The paresis

disappeared and cystoscopic examinations, repeated at regular intervals, showed progressive improvement of the cystitis as well as of the ulcers. The encrustations gradually came off and were discharged with the irrigations. After two months the bladder mucous membrane was normal. In some places, where the larger ulcers had been, there were white scars on the mucous membrane, a sign that they had not been superficial erosions, but deep ulcers.

Asch says that we will probably not err in saying that the ulcers and encrustations in von Engelmann's third case were only indirectly caused by syphilis.

Asch,<sup>21</sup> in 1911, reported the case of a man, aged forty-five years, who had suffered for three months from bloody urine; no other symptoms. General condition good. Previous treatment had not affected the disease. Suddenly a hemorrhage appeared without explainable cause. Its duration from the beginning to the end of urination, and the failure of previous methods of treatment, caused Asch to suspect a tumor. The lack of other symptoms indicated that it was probably in the summit of the bladder. Cystoscopic examination showed papillæ the size of a hazel-nut about 0.5 cm. externally from the opening of the left ureter, and directly above, partially covered by the papillæ, an ulcer about 1 cm. in diameter with hard, infiltrated edges and grayish-yellow purulent masses covering its base. This ulcer aroused a suspicion of syphilis. The patient admitted that he had had syphilis about twenty years previously, and that he had hardly been treated at all. Bacterial examination of the urine showed that there were no gonococci or tubercle bacilli.

This shows that syphilis may produce papillomata which are very similar to the ordinary papillomata in appearance.

Asch reports a second case of a man, aged thirty-five years, who, for three months, had had severe bladder hemorrhages and, for six weeks, painful desire to urinate. The urine had recently become turbid and contained many leukocytes and a considerable number of red cells. There was an ulcer on the right thigh which had persisted for five months, and which had had all the characteristics of a gummatous ulcer. Twenty years before the patient had had a hard chancre which was only superficially treated, but no other symptoms until the gummatous ulcer developed. Cystoscopic examination showed a large gummatous ulcer in the fundus. It was 2 or 3 cm. in diameter, had edges very much infiltrated, and projected 1 cm. into the bladder. The base of the ulcer was yellowish and projected above the mucous membrane. There was no doubt of the diagnosis. The patient received an intravenous injection of salvarsan, 0.5 gm.; the result was excellent. After four days the gummata of the thigh and the bladder had completely disappeared. Cystoscopy showed a normal bladder.

Picot,<sup>39</sup> in 1912, gives the details of one case of vesical syphilis in a patient, aged fifty-three years, who denied all venereal disease. The patient began to have urinary symptoms eight years previously, apparently without cause; at the end of two years he was operated on

for vesical calculi. One day, a year afterward, cystitis increased and brown masses appeared in the urine; later most of the urine passed through the rectum. Cystoscopy showed the left ureteral orifice round, large, and gaping. A little below this orifice the vesical wall was thickened and sclerotic. Large projections were visible, intersected by longitudinal furrows on which finer ones branched. This aspect recalls that of a parquetté floor. The right ureteral orifice was elongated transversely. The bladder mucous coat which surrounded it was pale. This pallor contrasted with the deep coloration of the region of the trigone. Above and below the ureteral orifice, almost touching it, were found small irregular plaques of a clearer red, surrounded by a sort of halo. The edges were irregular, and a little polycyclic. It was above this region that the more characteristic elements were discovered. At this point the vesical wall was covered by numerous ulcerations of some depth; they were very variable as to dimensions and some were confluent. Their border was irregular and polycyclic, the base was red at the periphery, paler at the centre. These elements had the aspect of ulcerous syphilides. The posterior part of the bladder on the right side presented the same parquetté aspect as that which has been described of the left ureter. In the midst of the projections, in a cavity, a fistula was found. It was an irregular orifice, the borders of which were cut into peaks. It appeared to be about 0.25 cm. in diameter. Below this orifice, floating in the liquid were two blackish bodies (*débris* of fecal matter).

The summit of the bladder was occupied by small tuberculous masses, some of which were massed together, others isolated, slightly ulcerated at their apices. At the left posterior part of the bladder, at a point where the preceding formations were found there was a large varicose vessel, emerging into the bladder like a temporal arteriosclerosis. Papulo-ulcerative elements in a fistula, the edges of which are cut into peaks, suggest syphilis. The patient denied having contracted a chancre, but the Wassermann reaction was found to be positive.

R. Picker,<sup>38</sup> in 1913, reported the case of a solitary gumma of the bladder in which he maintains that the diagnosis is the earliest on record for this class of cases. The Wassermann examination was negative. This, however, was before the ulcer had broken down. There was no hemorrhage. The clear urine and the normal adnexa pointed to the localization of the condition in the bladder. Complete healing took place under specific treatment.

Cystoscopy showed the vault thoroughly smooth and pale yellow. Both ureteral folds were clearly defined throughout their whole course. The openings of the ureters appeared at the end of the ureteral folds in the form of small, papillæ-like protuberances. The stream of urine from both sides was strong. At the posterior end of the trigone, the mucous membrane appeared entirely normal and smooth, while on the internal side of the right ureteral fold, there was a cystoscopic picture of a prominence about the size of a quarter of a dollar, which was sur-

rounded by a narrow but livid red border which gradually passed over into the normal neighboring mucous membrane. The surface of the prominence itself appeared yellowish, tinged with red, and was demarcated from the livid border by a margin formed of five segments coming together at an obtuse angle. In the middle of this formation there was a depression covered with a thick whitish eschar about the size of a five-cent piece. The entire formation was like a pansy in shape. Healing took place under specific treatment.

Gayet and Favre,<sup>25</sup> in 1914, reported under this heading 3 cases. The first had the following history:

A tabetic, aged sixty-six years, whose urinary symptoms began fifteen months previously with a pollakiuria, most frequent at night, gradually growing worse; repeated attempts at cystoscopy were not successful. Later, however, the following picture was visible. On December 9, 1913, the patient continued to bleed; ureteral orifices clearly visible. Medium prostatic projection; at its site an ulcer with irregular contour. Two other ulcerations were found on the upper side of the left ureteral orifice, in the form of papules, covered over with a greenish-white exudation. This suggested the specific nature of the lesion and the patient who had been until then treated by washings only, was subjected to weekly injections of calomel and potassium iodide. The Wassermann was positive at this time. After the first week of treatment, the hematuria ceased, not to reappear, but incontinence persisted. January 17, 1914, after six months of treatment, cystoscopy showed a little vesicular vascularization, especially in the prostatic region, but there the preëxisting ulceration was no longer to be seen. The neighboring ulcerations of the left ureter were in process of cicatrization; there was a sort of gray edematous covering.

They conclude as follows: "An old syphilitic, tabetic, attended with chronic retention, with ordinary cystitis, had suddenly a hemorrhage; the hemorrhage repeated itself in capricious manner, without provocation, recalling the hemorrhage of neoplasms. It persisted until the day when mercurial treatment was begun and then disappeared rapidly. The cystoscopy, which at this time was not clear, gave the impression that there were ulcerations of specific nature. In ten weeks, under the influence of mercury, iodides, and finally neosalvarsan, these ulcerations completely scarred over.

"The only objection which could be made to the diagnosis of vesical syphilis is that it might have been a question of ulcerous cystitis, occurring by ordinary infection in a tabetic bladder during retention, or the result of trophic lesions of medullary origin."

Gayet and Favre's second case is that of a patient, aged fifty years, who denied venereal history. Seven years previously there was perforation at the junction of the hard and soft palate. The patient suddenly had very intense hematuria, accompanied by pains at micturition and with pollakiuria; these functional symptoms diminished soon; the hematuria was pronounced from the moment of

entrance to the hospital and did not quiet down under the influence of rest. The first cystoscopy was not satisfactory on account of the hemorrhage. Salvarsan treatment was instituted. Later cystoscopic examination showed the following (five days after the first injection and one month after the patient's entrance): The base of the bladder was red, the remainder of the mucous coat less red, but there existed numerous papillomata around the neck and the general aspect of a cerebral convolution still persisted, but with ridges and folds less pronounced. Later, the patient, who had quit the service, returned for a cystoscopy. She had not had the least trouble or the least hematuria since the last examination. Her bladder was entirely normal, except at the boundary of the neck, where several ridges still persisted, with the mucous coat a little irritated.

The third case was that of a woman, aged thirty-five years. Eleven years previously she had had a chancre on the lip; fifteen days before her admittance to the hospital she suddenly, without premonitory symptoms, began to urinate blood. The first hematuria was of terminal character and accompanied by pain with the last drops. There was pollakiuria, especially on standing. Cystoscopy showed the bladder white throughout; the ureteral orifices presented nothing abnormal. The trigone was, on the other hand, somber red, with a median projection recalling a prostatic lobe. The periphery of the neck was red, the folds much affected. No ulcerations were seen. Vaginal examination was negative. Simple rubbings brought about complete cure.

**Pathology.**—The pathology of vesical syphilitic lesions is the same as that found in syphiloma in other parts of the body.

**Symptoms.**—SECONDARY SYPHILIS.—*Age.*—It generally occurs in early adult life.

During the period of secondary eruption, if the infection is severe, there frequently occurs a diffuse syphilitic cystitis.

If one stops to consider that during the period of secondary invasion the spirochetes localize in every organ of the human body, it is not surprising that at times there should be vesical lesions during this period; however, in the majority of cases, they are overshadowed by the general infection and rapidly lose their identity once specific treatment is instituted.

In the more severe infections there are all the symptoms of acute and chronic inflammation of the bladder, *i. e.*, pyuria, pollakiuria, pain, and tenesmus. It must not be forgotten that secondary lesions, no matter where located, are not destructive, and as a consequence the accompanying symptomatology may be insignificant, compared with that of gumma.

During this period secondary symptoms, such as mucous plaques, condylomata and secondary skin eruptions are common.

**Cystoscopic Examination.**—During this period the vesical mucosa often shows an increased vascularization, or more or less congestion. Scattered diffusely over the mucosa are little islands of mucus. In the more severe forms the exact duplicate of the mucous patch may

occur; this may be multiple and become so extensive as to form distinct ulcers.

**TERTIARY SYPHILIS.**—*Age.*—Gumma of the bladder occurs especially in middle life, thirty-five to fifty years of age, but may occur earlier or later.

1. Pains are variable, intermittent or continued, or radiating at times, increased on deep pressure, little marked if the lesions lie on the base of the bladder; much more marked at the time of micturition if they lie at the vesical neck.

2. Hematuria is the most constant and important symptom. There may be a terminal hematuria, intermittent hematuria, or a constant hematuria, lasting from the beginning to the end of urination. This may be scant or profuse, repeating at irregular intervals, often acting in a peculiar manner, capricious at times, as in hemorrhages due to neoplasms.

3. Pollakiuria is a frequent symptom; the urine almost always contains a large quantity of red cells and leukocytes; rarely have any organisms been found.

As a rule the general physical condition is little affected.

*Cystoscopic Examination.*—Tertiary syphilis manifests itself on the vesical mucous coat in two ways:

(a) Ulcerations.

(b) Papillomata.

The diagnosis of ulcerations is not difficult; they may be rounded, more or less extended, isolated or multiple; they make projections into the vesical cavity, the edges are infiltrated, cut into peaks, and the base is generally covered with a yellow, purulent mass.

Sometimes these lesions appear as veritable tumors, sessile or pedunculated, capable of simulating absolutely the character of a fringed polypus or a series of unequally enlarged papillomata; they may be found in the region of the trigone, around the vesical neck, seeming at times to continue into the urethra.

It must not be forgotten that syphilis of the bladder may have its course quite independent of other syphilitic manifestations. The most varied forms will be observed, from simple hyperemia of the mucous membrane to extended breaking down of gummatous tissue.

**Diagnosis.**—*Secondary and Tertiary Syphilis.*—Syphilis may affect the bladder as well as any other part of the body, but there is no such thing as chancre of the bladder. Syphilitic affections of the bladder that produce severe destructive symptoms belong to the tertiary period.

Syphilitic ulceration of the bladder mucous membrane may be solitary or appear at the same time with syphilis of the skin and other mucous membranes.

During the secondary stage of the disease on the mucous membrane of the bladder may be found a general or localized eruption, which may be in the form of ulcerous processes resembling mucous patches.

It is easy to mistake their etiology, particularly gummas that simulate

papilloma and single ulcers, because a gumma may be transformed into a seemingly single ulcer by central necrosis.

It is often difficult to distinguish gummas from papilloma, so that their syphilitic nature can only be recognized by simultaneous appearance of syphilitic ulcers either in the bladder or other parts of the body, or by the presence of some other tertiary lesion.

These ulcers may extend deep and lead to perforation of the bladder peritoneum or to vesicovaginal fistulae.

It is well in every case of papilloma to get a thorough history of the patient, and make careful and thorough examination of the skin and other organs.

Simple solitary ulcers should arouse suspicion of syphilis, especially if tuberculosis can be excluded by bacteriological examination. Syphilitic ulcers can be distinguished from ordinary or tuberculous ulcers by the infiltrated edges which project more or less into the ulcer cavity.

As soon as a suspicion of syphilis is aroused a Wassermann examination should be made by a reliable serologist, all local treatment should be discontinued and specific treatment instituted.

The gummas generally cause symptoms of new growth and hemorrhages which are not influenced by rest or other treatment. Hemorrhages from gumma may last from the beginning to the end of urination, while hemorrhages in ulcers of the bladder, even if syphilitic, are terminal.

Ulcers are more apt to cause pyuria than gumma.

The number, size and location of the lesions, either gummas or ulcers, greatly influence the accompanying symptomatology.

**Treatment.**—It must not be forgotten that vesical syphilis, whether secondary or tertiary, is only an incident in the course of a general syphilitic infection and that after the vesical lesions are healed, every effort known to modern medicine should be made to safeguard the patient from a relapse in other organs.

The Wassermann reaction offers the best and most efficient guide in the management of syphilitic cases. Unfortunately, the tendency is to give too little treatment and to stop when the first negative reaction is reached.

Under the new therapy (salvarsan and mercury) all cases that come under observation should be treated at least nine months after the negative goal is reached, giving during this period 150 rubbings of mercury and at least two intravenous injections of salvarsan. It must be distinctly understood that treatment should be continued vigorously during the "negative phase," in order to secure permanent results.

Salvarsan given every week or ten days for four or five doses, then every month, with mercury rubbings, controlled by biological examinations, constitute the best method of treating the patient. It should be borne in mind that dilatory and haphazard treatment, while healing the lesions, often produces both a salvarsan- and mercury-fast spirochete which when localized in other regions (spinal fluid) may never be dislodged.

Spinal fluid examinations, while appearing superfluous, are as much

indicated here as in other forms of visceral syphilis, and a physician with the patient's best interests at heart should certainly insist on making them.

**Spinal Cord Affections Simulating Bladder Disease.**—Besides these secondary and tertiary syphilitic diseases of the bladder there are considerable number of cases that come under observation on account of spinal cord disease (progressive paralysis and tabes).

Unfortunately a Wassermann reaction on the blood is not the last word in diagnosis, as it is often negative in this class of infections; unless a spinal fluid examination is made the true cause of the trouble may be overlooked until the degeneration has gone so far that restoration of function is not possible.

While it is true that trabeculization of the bladder without other known cause of obstruction should cause a strong suspicion of syphilis, especially in the absence of other nerve degeneration findings, a spinal puncture should not be neglected.

Many of these cases, on account of treatment and catheterization, present mild grades of cystitis; the cystoscopic picture is therefore altered and a diagnosis is impossible with the cystoscope.

*Treatment.*—While practically hopeless in the advanced cases, much can be done if the condition is diagnosed early. Here, as in other forms of syphilitic lesions, regular, persistent treatment by the Swift-Ellis method, or the combined method of salvarsan and mercury, if given intensively after the method of Collins, is most satisfactory, the treatment being controlled by serological examination of the blood serum and the spinal fluid.

### SYPHILIS OF THE URETER.

Syphilis of the ureter is rare. A case has been described by Hadden, as mentioned by Osler and Gibson.

While involvement of the ureter has been observed in conjunction with bladder syphilis, it is impossible to recognize this condition alone except at autopsy.

**Essential Hematuria.**—While a great deal of speculation has been brought forward in regard to the etiological factors in essential hematuria, few have considered the possibility here of secondary ulcers or gummatous formation, and it might be well in this class of cases to thoroughly eliminate this form of infection before ascribing some doubtful etiology.

### SYPHILIS OF THE KIDNEY.

Syphilitic nephritis manifests itself in the following forms:

1. Acute parenchymatous syphilitic nephritis.
2. Chronic interstitial nephritis.
3. Amyloid kidney.
4. Gummatous kidney.

Under this heading will be considered only those forms of syphilitic infection in which the symptoms and pathology can be actually attributed to the *Spirochaeta pallida*, the first and the fourth.

**Acute Parenchymatous Syphilitic Nephritis.**—**Synonyms.**—Acute early syphilitic nephritis; nephritis syphilitica præcox.

The first to acknowledge syphilitic kidney diseases was Bayer.<sup>47</sup> He wrote as follows: "I have seen cases in which the influence of constitutional venereal diseases seemed so striking that I did not hesitate to attribute, at least to a great extent, the development of kidney diseases to the venereal cachexia."

The first description of kidney syphilis was given by Virchow.<sup>63</sup> He observed that simple nephritis is often found in syphilitics, but that does not justify considering them specific, because they have no characteristic signs.

Guiol<sup>50</sup> published the first report of syphilitic albuminuria and Perodu<sup>57</sup> the first description of early acute syphilitic nephritis.

Karvonen<sup>52</sup> and Neumann<sup>55</sup> are among the writers on the subject. More recently, Bauer,<sup>46</sup> Habetin, Erich Hoffmann,<sup>51</sup> Osthelder,<sup>56</sup> Welz,<sup>64</sup> Tach,<sup>62</sup> Moritz<sup>53</sup> and Damask<sup>49</sup> have written communications, while the excellent monograph of Munk<sup>54</sup> ranks as an authority on the subject.

Owing to the fact that the causative agent in syphilis was so long misunderstood, few realize that during the period of secondary localization (secondary eruption), the spirochetes are actually present in every organ of the human body to a greater or less extent, and the fact that syphilis may cause disease of the internal organs during the eruption of the first exanthem or even for some time before, is recognized possibly by syphilologists alone.

Hoffmann has shown that transmissible spirochetes circulate in the blood three weeks before the outbreak of the eruption.

For a long time there has been a great deal of doubt concerning the specific nature of the nephritis appearing in the early stage. Senator,<sup>59 60</sup> an expert himself on kidney diseases, did not admit the real nature of this condition in 1902.

We are astonished to find that today a great number of cases of disease of the heart, bloodvessels, liver, kidney and joints in syphilitics are due to the *Spirochaeta pallida*, yet more surprising is the number of syphilitics who do not know that they are affected. It has only been in the last ten years that the syphilitic etiology in many cases of aortic aneurysm has been recognized.

In Munk's clinic, among 260 cases of visceral syphilis with a strongly positive Wassermann, 38 per cent. of the men and 84 per cent. of the women did not know that they had the infection.

Notwithstanding the advance in our knowledge of visceral syphilis, the subject has been more clearly understood only since the introduction of the Wassermann reaction in practice.

**Etiology.**—This form of nephritis is a hematogenous injury, not a tissue process, and it is caused by the presence of the *Spirochaeta pallida*.

By most authors, therefore, syphilitic nephritis, as well as nephritis caused by scarlet fever and other infectious diseases, is attributed to a toxic cause. The idea that the continued administration of mercury in syphilitics causes a nephritis has long been held.

The question of whether the kidney injury in these cases is due to syphilis or to mercury is decided at once by the lipid findings in the urine, reference to which will be made later. In the nephritis caused by mercury there is never lipid degeneration, therefore no lipid casts are found in the urine.

Naturally there are all sorts of transitional forms, from very severe cases of nephritis to slight and quickly passing albuminurias, which many syphilographers, especially the French, maintain are very frequent, but according to Hoffmann, are rare in Germany.

Since the discovery of the *Spirochæta pallida* we are in a position to test its relation to the kidney. In these investigations it has been frequently found in the kidneys of congenitally syphilitic children. They have been reported as having been found in the urine in cases of acquired syphilis.

Recent syphilis can generally be demonstrated by the clinical symptoms; however, these may be so masked by severe edema that they are not apparent. It is more difficult to palpate the glands, and even the eruption is not so easy to recognize on an edematous skin. Therefore it is particularly important to make a diagnosis either by finding the spirochetes in the urine or by the Wassermann reaction.

From Hoffmann's experience in determining the syphilitic etiology in a given case, and from the recent advances in syphilology, he formulated the following signs as an indication of early syphilitic nephritis:

1. The demonstration of recent syphilis by clinical symptoms, finding the *Spirochæta pallida* in primary or secondary lesions, and a positive Wassermann reaction.

2. Characteristic signs in the urine, such as enormous albumin contents, and the finding of the *Spirochæta pallida* in the sediment of the urine removed by catheterization.

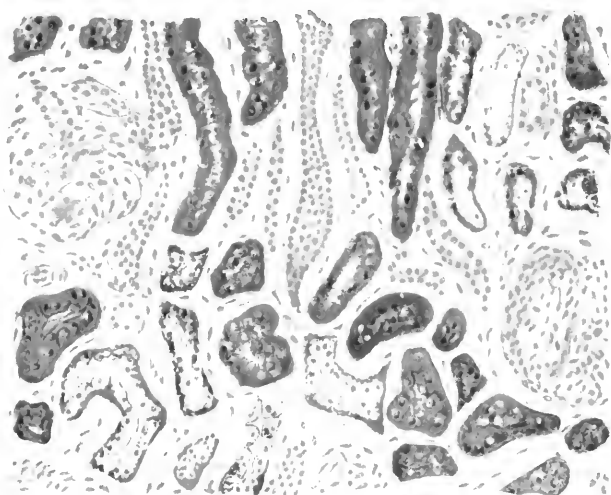
3. The influence of specific treatment, which is almost always evident if mercury and salvarsan are correctly used.

According to Hoffmann, acute syphilitic nephritis may develop in two ways: either gradually, without any specific symptoms, so that it may be overlooked unless the urine is examined, or in a more or less stormy fashion, with marked edema and fluid in the body cavities. However, most patients seek the physician's advice on account of general edema and weakness; this gradually progresses and anemia may be marked.

The principal and most characteristic symptom is the anemic appearance of the patient, with a more or less severe edema; the patients complain of a great weariness and weakness; sometimes there is difficulty in breathing; headaches are not very frequent; vomiting, as a rule, appears late, as well as other uremic symptoms.

As long as there is no complication, fever rarely goes higher than 38°

PLATE II



Acute Parenchymatous Syphilitic Nephritis. (Munk.)



to 38.5° C.; chills are not present. The only symptom that the patient complains of is that on urinating he notices a small amount of urine.

**Urinary Findings.**—These are especially characteristic. The volume varies from 300 to 1200 c.c.; the color is normal yellow, reaction acid, specific gravity very high; albumin contents generally high, up to 28 per 1000. Microscopically, examination of the urinary sediment shows a small number of red cells, fairly numerous white cells, many epithelial, and a few hyaline, waxy and granular casts, but most of them lipoid casts. Under the polarizing microscope, in fresh specimens the whole field may be strewn with double refracting drops, some of them in crystalline form and some of them cylindrical.

Recently, Stengel and Austin,<sup>61</sup> in this country, have examined the urine with a polarizing microscope fifty-eight times in 46 cases. Of the 46 cases, 23 showed nephritis with an abundance of albumin and casts in the urine. Of these 23 cases, 6 had positive Wassermanns; 3 had strong presumptive evidence of syphilis, but not positive Wassermann. Fourteen had not the slightest evidence of syphilis. The 6 cases with the positive Wassermann all showed lipoids in the urine, whereas, in the 14 non-syphilitic cases only 5 showed lipoids in the urine.

**Pathology.**—According to Munk, the pathological anatomy of this form of syphilitic kidney, at the height of the disease, corresponds to the co-called large white kidney, which name has been given it on account of its macroscopic appearance. The color is really not white, but a grayish yellow, due to the lipoid contents and the cloudy swelling of the cortical substance.

The kidney for the most part is flaccid and soft. On the surface of the kidney it is possible to see, at times, individual groups of convoluted tubules appearing as yellow flecks standing out from the remaining grayish-yellow turbid ground substance.

On cross-section the cortical substance seems increased in breadth and so swollen that it stands out over the medullary substance. The medullary rays may be recognized as gray, watery stripes, often completely transparent and gelatinous, while the cortical pyramids appear turbid, intersected by bright yellow stripes and flecks which are the convoluted tubules which have undergone fatty degeneration. The vessels are not well filled, while the vasa recta of the medullary substance are, so that there is a sharp contrast in the coloring of the two substances. Plate II gives a picture of a frozen section of such a kidney colored with sudan hamalaun. The lipoids are colored yellowish red; we see the convoluted tubules chiefly attacked by the lipoid degeneration. Besides the lipoid degeneration, some parts of the convoluted tubules show a somewhat indistinct appearance. These are in a state of cloudy swelling. The glomeruli, are, on the contrary, completely intact. The nucleus stains well and the interstitial tissue does not show any changes which indicate inflammatory processes, either cellular infiltration or productive proliferation. We have, therefore, an organ which has undergone a purely degenerative change. The cloudy swelling itself is a degenerative stage which may pass over into

fatty or lipid degeneration. A noteworthy fact is the rapid appearance of primary lipid degeneration of the kidney epithelium, without any further degenerative or later inflammatory changes.

Clinically, this type of syphilitic kidney is an acute nephritis, but from the point of view of pathological anatomy, it is a degenerative, non-inflammatory change of the organ of a chronic character, and can be set in a group by itself as a form of degenerative kidney disease peculiar to syphilis (Munk).

**Symptoms.**—The leading symptoms of nephritis following infectious diseases are: marked anemia and a considerable degree of dropsy, which is a dropsy of the body cavities rather than a general anasarca, as in syphilis. Headache and rise of temperature are only exceptionally observed in uncomplicated cases. Marked uremia is unusual if there is not a considerable degree of stasis; the liver and spleen are involved only moderately, if at all. Murmurs may be demonstrated in the heart from time to time, but they are generally due to anemia. Accentuation of the second aortic sound is rare, at least in the beginning, and at that time there are no signs of increased blood-pressure.

The symptoms of nephritis may appear in a few months, or not until some years after the infection. The Wassermann reaction may be strongly positive or only weakly positive. However, a positive Wassermann reaction is not sufficient to decide the question whether in a given case we have a syphilitic nephritis or merely nephritis in a syphilitic patient, but it fills the gap in the history of patients who do not know that they have the disease, and it increases the number of demonstrable syphilitic cases in which the nephritis is observed.

**Urinary Findings.**—These are of the greatest importance. The daily amount is small, sometimes as little as 300 c.c. The urine is turbid, yellow or brown in color and macroscopically only rarely shows blood. The reaction is always acid, specific gravity high, sediment abundant. Its chief constituents are double refracting lipid substances which are sometimes free in individual droplets or clumped together, or they may appear as fine droplets in the numerous epithelial cells, but a more characteristic formation is that of large opaque casts. Pure hyaline and granular casts are found, but they are rare. There are also considerable numbers of leukocytes, the mononuclear form predominating.

It is true that lipid substances occur in the urinary sediment in secondary contracted kidney, but not in such amount as in parenchymatous syphilitic kidney, and the albumin contents also are lower.

Munk says that greater difficulties lie in differentiating this form of kidney from large white amyloid kidney. The urinary findings are quite similar, but the amyloid kidney is distinguished by the fact that in addition to lipoids it has relatively numerous single refracting fat elements. These two forms of disease are different also in the time of their appearance. While amyloid kidney generally develops slowly, still it leads to severe clinical symptoms; syphilitic disease appears early with very severe symptoms, especially marked dropsy. Within

ten days after the first appearance of albumin in the urine, the condition may become threatening.

Munk hopes that this form of acute parenchymatous degenerative kidney will be more often recognized in the future, since it can be recognized only by means of examination of the sediment by the polarizing microscope.

Unfortunately, most cases that come to the medical clinics have severe symptoms, and as a consequence this makes the number of cases appear relatively small, but there is no doubt that there are a large number of cases with mild symptoms that are observed and treated by syphilographers.

**Differential Diagnosis.**—Differential diagnosis can be made between acute parenchymatous syphilitic nephritis and nephritis resulting from other infectious diseases.

**Prognosis.**—In most cases, with proper treatment and care, the patients recover from the first stage, even when there has been high-grade edema and weakness of threatening character. The edema may last two or three weeks, or may disappear earlier, sometimes very rapidly. The quantity of urine increases, the formed constituents in the urine decrease, but the albumin contents remain rather high. As soon as the edema disappears completely, the patient usually regains his strength and appetite and normal conditions return. The headaches gradually pass away. The amount of urine may vary for awhile in the formed elements; especially lipoids may be observed from time to time, but it is the high albumin contents that may persist for months afterward, rising and falling indefinitely.

The relatively benign course of acute parenchymatous syphilitic nephritis is surprising, and like all other forms of syphilitic infection, the prognosis depends on the prompt diagnosis, for the longer the kidneys remain jammed with spirochetes with their attending systemic symptoms, the more difficult will it be to bring about permanent resolution.

According to Munk's views, a fatal outcome in the acute stage is very rare in spite of the severe symptoms, such as dropsy, anemia, weakness, and so forth.

Hoffmann says: "The prognosis of early acute syphilitic nephritis, which was good before, has become even better since the introduction of salvarsan."

We have two powerful remedies, both without danger if properly used. In the majority of cases the albuminuria is completely overcome. Death is rare and when it occurs is perhaps due to improper treatment. The quick cure is due to the double action of salvarsan and mercury against the spirochetes through the blood and urinary tubules.

**Treatment.**—In every case of syphilis which is presented for examination and treatment a careful urinalysis should be made, and if later on an albuminuria presents itself, its etiology will not be so obscure. If a patient comes for treatment at the height of his disease, it is generally

extreme dropsy and oliguria that demand attention. As this condition is caused by the presence of the *Spirochaeta pallida* within the substance of the kidney, as soon as specific remedies can be applied (salvarsan and mercury), the condition should improve. Unfortunately, diuretics do harm; the chemical irritation caused by them causes the degenerated epithelium to be discharged suddenly and in large quantities. Such a considerable desquamation of kidney elements is not without danger for future restoration of the kidney. Diuretics, if used at all, should be of the mildest form; diuresis should be taken care of in a compensatory manner by free saline catharsis. Whenever the anasarca has advanced to a considerable degree, skin drainage may be resorted to.

As soon as possible small doses of salvarsan should be given. It is perhaps best not to give over 0.2 gm. or 0.3 gm. at a dose, and, as soon as the dropsy has disappeared, rubbings may be combined.

Hoffmann gives salvarsan the preference in nephritis. It does not cause irritation of the kidneys, except in very rare cases. Some authors hold that it is sufficient to cure.

The dietetic management in this class of cases deserves some little attention. Eggs, milk and carbohydrates are used as an exclusive diet in the beginning. Munk recommends some form of malt extract to be added to the milk, and, on account of the severe anemia, iron is given as soon as the intestinal tract will stand it. Meat should not be withheld long.

The use of baths and hot packs is contra-indicated in this form of nephritis, because the advantage to be gained from them is not in proportion to the bad effects they have in increasing the general weakness.

The general specific treatment for the syphilitic condition must, of course, be carried on, regularly controlled by the Wassermann reaction.

CONCLUSIONS.—Munk's conclusions are the following:

In the clinical diagnosis of nephritis more attention must be paid than heretofore to the different degenerative processes in the kidney.

The examination of the urine may give valuable information on this point.

The demonstration of fat and fat-formed elements in the urine points to a fatty degeneration of the organ in the different forms of cachexia. The presence of a greater or less amount of fat-formed elements shows the destruction of kidney parenchyma in acute forms of nephritis.

The demonstration by means of the polarization microscope of double refracting lipoids in the sediment of the urine is a reliable criterion for differential diagnosis between acute inflammatory and chronic degenerative kidney diseases.

### GUMMA OF THE KIDNEY.

Gumma of the kidney is rarely recognized except at autopsy.

It was Arnold Beer<sup>48</sup> who gave the first description of gumma of the

kidney. Gummatus disease of the kidney generally appears in the form of circumscribed miliary nodules varying in size from that of a grain of millet to that of a hazel-nut, which, as a rule, are limited to one kidney. They generally occur in the cortical substance, extending at times more or less deeply into the medullary substance, even as deep as the papillæ. Occasionally a single gumma occurs, but usually they are multiple.

On section these gummata show a peripheral part which is gray and transparent. They may be either soft or hard, with a necrotic centre consisting of caseous masses undergoing fatty degeneration. The periphery consists of tissue which is rich in cells and vascular tissue. In this tissue, or sometimes surrounded by it, there are atrophied urinary tubules, together with shrunken Malpighian bodies.

When these gummata have evacuated their contents, they may be resorbed by the lymphatics of the kidneys, and, when superficial, leave in their places cicatrices with corresponding deformities.

**Symptoms.**—As in gummata elsewhere, gummata of the kidney manifest themselves from seven to twenty years after the chancre first appears. The evolution of the gumma is slow and insidious and only exceptionally gives symptoms which permit of a diagnosis during life. In some cases, however, gummata that open into the pelvis of the kidney may soften and discharge their contents into the urine. As soon as this elimination of the contents occurs, the urine again becomes macroscopically clear, the condition remaining undiagnosed, thus leaving the true cause unsuspected.

Gummatous kidney, when greatly enlarged, may simulate a malignant tumor. In such instances, even in the absence of positive symptoms of syphilis, a Wassermann reaction may clear up a doubtful diagnosis. The possibility of a tuberculous kidney should be constantly kept in mind.

**Prognosis.**—Unless the attending interstitial nephritis is advanced, the prognosis is good.

#### BIBLIOGRAPHY ON SYPHILIS OF THE URETHRA.

1. Albarran: *Sem. méd.*, 1894, xiv, 489.
2. Bellet, Charles: *Contribution à l'étude du chancre syphilitique de l'urèthre*, Thèse de Paris, 1898.
3. Dey, W. P., and Kirby-Smith, J. L.: *Southern Med. Jour.*, 1913, vi, 21.
4. Du Castel: *Jour. d. praet.*, 1894.
5. Faitout, P.: *Gaz. d. hôp.*, 1897, lxx, 1045.
6. Fasoli: *Ann. d. mal. d. org. gen. ur.*, 1900, xviii, 954.
7. Fournier, Alfred: *Leçons sur la syphilis tertiaire*, Paris, 1899.
8. Fournier, Alfred: *Traité de la syphilis*, Paris, 1898–1901.
9. Gaucher and Druelle: *Bull. soc. franç. de dermat. et syph.*, 1909, xx, 122.
10. Gaucher and Rostaine: *Ann. de dermat. et syph.*, 1904, xxxv, 149.
11. Mauriac: *Syphilis tertiaire et héréditaire*, Paris, 1890.
12. Renault, Alex.: *Ann. de dermat. et syph.*, 1903, xxxiv, 932.
13. Renault, Alex.: *Bull. Soc. franç. de dermat. et syph.*, 1905, xvi, 215.
14. Rougier: *La syphilis tertiaire de l'urèthre*, Thèse, Paris, 1908–1909.
15. Simionescu, F.: *La syphilis de l'urèthre*, Genève, 1905.
16. Tanton, J.: *Progrès méd.*, 1910, xxvi, 607, 619.

## BIBLIOGRAPHY ON SYPHILIS OF THE PROSTATE.

17. Drobny: Med. Obozr., lxxv, 7; Ref. Ann. d. mal. vén., 1906, i, 376.
18. Rush, J. O.: Med. Rec., 1913, lxxxiv, 1028.
19. Wright, F. R.: Syphilis of the Prostate. Reported at a Meeting of the Am. Urol. Assn., November, 1912.

## BIBLIOGRAPHY ON SYPHILIS OF THE BLADDER.

20. Asch, Paul: Ztschr. f. Urol., 1911, v, 504.
21. Asch: Loc. cit.
22. Chezeliitzer: Zentralbl. f. d. Krankh. d. Harn- u. Sexualorgane, 1901, p. 6.
23. Fenwick: Casper's Handbuch der Cystoskopie, Leipzig, 1898.
24. Follin: Soc. de biol., April, 1849; Gaz. méd. de Paris, 1849, p. 492.
25. Gayet, G., and Favre: Jour. d'urolog., 1914, vi, 35.
26. Gräff, Karl: Beitrag zur Kenntnis der Blasensyphilis. Diss., Freiburg, 1906; also reported by Kraske, Chirurgenkongress, 1904.
27. Griwzow: Monatsber. f. Krankh. d. Harn- und Sexualorgane, 1899, p. 449.
28. Le Fur: Ann. d. mal. d. org. gén.-Ur., 1902, xx, 1519.
29. MacGowan, G.: Jour. Cut. and Gen.-Ur.-Dis., 1901, xix, 326.
30. Margouliès: Ann. d. mal. d. org. Gén.-Ur., 1902, p. 384.
31. Matzenauer: Arch. f. Dermat. u. Syph., 1900, p. 112.
32. Michailoff, N. A.: Ztschr. f. Urol., 1912, vi, 215.
33. Morgagni: De sedibus et causis morborum per anatomen indagatis. Lovanni, 1767. Cited by Proksch, J. K. Vierteljahrsschr. f. Dermat. u. Syph., 1879, p. 555.
34. Morris: Indiana Med. Jour., 1897-98, xvi, 5.
35. Mucharinsky, M. A.: Ztschr. f. Urol., 1912, vi, 376.
36. Neumann, Isidor: Syphilis. Nothnagel's spezieller Pathologie and Therapie, vol. xxiii, 2d ed. Wien, 1899, p. 683.
37. Pereschiwkin, N.: Ztschr. f. Urol., 1911, v, 732.
38. Picker, R.: Ztschr. f. Urol., 1913, vii, 192.
39. Picot, G.: Jour. d'urolog. méd. et chir., 1912, ii, 693.
40. Ricord, Philippe: Traité complet des maladies vénériennes, Paris, 1851.
41. Tarnowsky: Vorträge über venerische Krankheiten, Berlin, 1872, p. 199.
42. Toubien: Vrach. Gaz., 1904, No. 9. Ref. Monatsber. f. Urol., 1904, p. 494.
43. Vidal (de Cassis): Traité des maladies vénériennes, Paris, 1853, p. 169.
44. Virchow: Verhandl. der physikalisch-medizinischen Gesellschaft. zu Wurzberg, 1852, iii, 366.
45. Von Engelmann, G.: Fol. urol., 1911, p. 472.

## BIBLIOGRAPHY ON SYPHILIS OF THE URETER AND KIDNEY.

46. Bauer, Richard, and Habetin, Paul: Wien. klin. Wchnschr., 1913, xxvi, 1101.
47. Bayer: Traité des maladies des reins, Paris, 1840.
48. Beer, A.: Die Eingeweide Syphilis, Tübingen, 1867.
49. Damask: Mitt. d. Gesellsch. f. inn. Med. u. Kinderheilk. in Wien, 1912, xi, 119.
50. Guiol, V. F.: Sur l'albuminurie syphilitique, Thèse, Paris, 1867.
51. Hoffmann, Erich: Deutsch. med. Wchnschr., 1913, xxxix, 353.
52. Karvonen, J.: Die Nierensyphilis, Berlin, 1901.
53. Moritz, Alfred: Beitrag zur Kenntnis der Nierensyphilis. Diss., Heidelberg, 1912.
54. Munk, Fritz: Zeitschr. f. klin. Med., 1913, lxxviii, 24.
55. Neumann, Isidor: Syphilis. Nothnagel's spez. Path. u. Therap., Wien, 1896, xxiii, 436.
56. Osthelder, F.: Vereinsbl. d. pfälz. Aerzte, 1913, xxix, 200.
57. Perodu: De l'albuminurie dans la période secondaire, de la syphilis, Mém. et compt. rend. de la Soc. d. sc. méd. de Lyon, 1867, vi, 88, 196.
58. Power and Murphy: System of Syphilis, London, 1901, iii, 79.
59. Senator: Ueber die acut-infektiösen Erkrankungsformen der constitutionellen Syphilis, Berl. klin. Wchnschr., 1902, xxxix, 482.
60. Senator: Erkrankungen der Nieren. Nothnagel's spez. Path. u. Therap., Wien, 1896, xix.
61. Stengel and Austin: Am. Jour. Med. Sc., 1915, cxlix, 12.
62. Tach, Jean: A propos de deux observations de néphrite précoce chez des syphilitiques, Thèse, Bordeaux, 1913.
63. Virchow: Virchows Arch., 1858, xv, 217.
64. Welz, A.: Deutsch. med. Wchnschr., 1913, xxxix, 1201.

## SECTION II.

# THE PENIS AND URETHRA.

---

### CHAPTER VI.

#### ANATOMY, ANOMALIES AND INJURIES OF THE PENIS.

By H. A. FOWLER, M.D.

#### ANATOMY OF THE PENIS.

THE penis is the male organ of copulation. It is also concerned with urination. It therefore has a double function: genital and urinary. Its anatomical structure is peculiarly adapted to subserve these two functions. It is composed chiefly of erectile tissue separated into three parallel, cylindrical segments, by tough fibro-elastic investments. The two larger segments, the corpora cavernosa, lie side by side on the dorsal surface and make up the main bulk of the organ. In the groove on their under or ventral surface is placed the third or smaller segment, the corpus spongiosum, which surrounds the urethra and expands distally to form the free end of the penis. These three bodies are bound together by a common sheath of dense fibro-elastic tissue, called Buck's fascia, and the whole covered by integument and subcutaneous layers. The size of the penis varies greatly in different individuals and bears no constant relation to general physical development. A large robust man may have a small penis, while a small undersized man may present an organ of unusual proportions. The average length of the penis, when it is flaccid, is from three to four inches; when erect, from five to seven inches. Its circumference is about three inches.

**Corpora Cavernosa.**—The corpora cavernosa, composed of erectile tissue, are closely united in the greater part of their extent. They arise, one on each side, in the form of a dense, flattened, tendinous attachment from the ascending ramus of the ischium. They converge rapidly and meet just in front of the arch of the symphysis pubis. These two extremities form the root of the penis, and are called the crura penis. The anterior extremities are separated slightly and terminate in rounded, blunt ends which fit into corresponding depressions on the under surface of the glans penis. The average length of the corpus cavernosum is six inches; its diameter one-half inch.

They are invested by a dense fibro-elastic sheath or tunica albuginea. This sheath, according to Henle, is 2 mm. thick when the penis is flaccid,

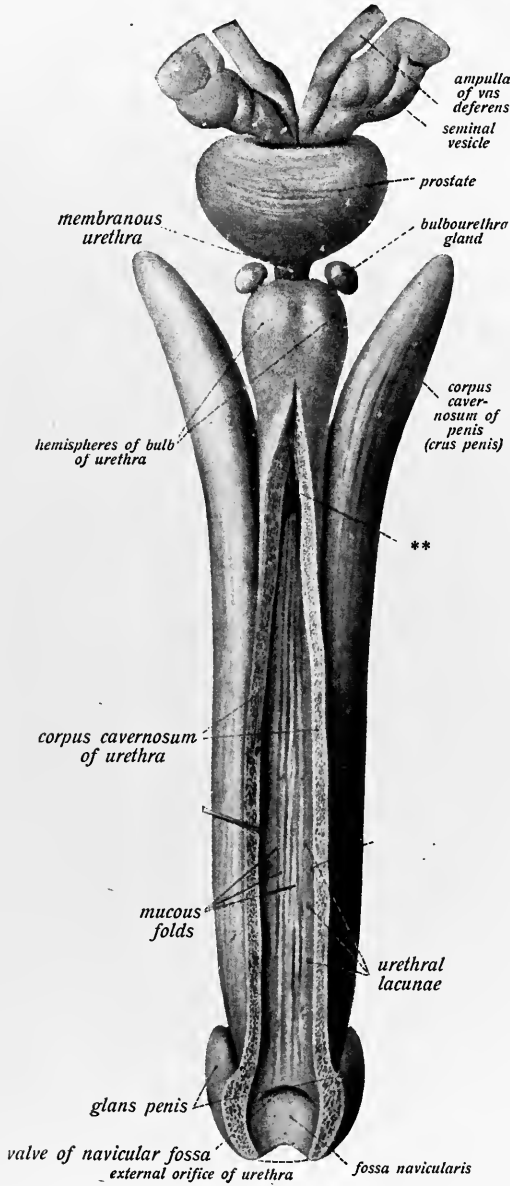


FIG. 112.—The male urethra with the corpora cavernosa of the penis, the bulbo-urethral glands, and the prostate. (Sabotta.)

and only 0.25 mm. thick during erection. It is, however, remarkably tough and strong, being capable of supporting the entire weight of the

body. It consists of two layers: an outer, of longitudinal fibers common to both bodies; an inner, of circular fibers surrounding each body separately and forming a median partition, the septum pectiniforme. This septum is incomplete; numerous perforations allow free intercommunication between the two corpora, thus ensuring symmetrical distention during erection.

While this sheath is very strong it is also very elastic, due to the predominance of elastic tissue. This allows for the great variation in size during repose and erection. There are no muscle fibers in the tunica albuginea. The angle between the rounded, anterior extremities of the cavernous bodies is filled with a dense fibrous expansion which projects forward into the glans in the form of a central stalk called the anterior ligament of the corpora cavernosa.

The inner layer of the tunica albuginea gives off numerous fibrous septa, some thick and lamellated, others fine and filament-like, which anastomose freely and divide the inclosed space into innumerable irregular spaces or areolæ. These trabecula contain unstriated muscle fibers in addition to connective tissue and elastic fibers, and form the supporting framework for the bloodvessels. The areola spaces thus formed communicate freely with each other and with those of the opposite body through the medium of the septum. They are lined by endothelial cells and represent dilated capillaries, communicating with the afferent artery on the one hand and the efferent veins on the other. There is no direct vascular communication between the corpora cavernosa and the corpus spongiosum or glans.

**Corpus Spongiosum.**—This is composed of erectile tissue similar in structure to the corpora cavernosa. It presents a central shaft and two expansions, one at either extremity. The posterior dilated extremity, called the bulb, lies in front of the triangular ligament in the angle formed by the converging crura. The anterior extremity is expanded into a cone-shaped body, the glans penis, which caps the corpora cavernosa. The glans presents at its posterior border a flange-like expansion, the corona glandis. Behind this is a deep sulcus, the coronary sulcus or neck of the penis. The urethra perforates the corpus spongiosum axially, terminating in a slit-like opening at the tip of the glans, the meatus urinarius. Within the bulb the urethra is not centrally placed, but lies nearer the dorsal surface, hence a greater thickness of spongy tissue covers the lower or ventral aspect of the urethra at this level. In the glans these relations are reversed, there is little or no erectile tissue below or ventral to the urethra. The fibro-elastic sheath surrounding the corpus spongiosum is separate and distinct from the fibrous investments of the cavernous bodies, which permits the easy dissection of the former from the latter.

The glans is usually described in the text-books of anatomy as the expanded extremity of the corpus spongiosum, hence anatomically and morphologically a part of this body. The studies of Retterer (1892) upon the development of the penis in embryos and in the human fetus of different ages led him to quite different conclusions. According to

this author the spongy body surrounded by its fibrous elastic sheath accompanies the urethra as far as the meatus, but does not present any expansion at its anterior extremity. The central or axial portion of the glans is formed, therefore, of the anterior extremities of the corpora cavernosa and the corpus spongiosum. This is surrounded by a peripheral layer, much like a muff, particularly well developed dorsally, which represents the cutaneous and fibrous coverings of the penis at this point. Within this layer the terminal branches of the dorsal arteries and nerves of the penis end. At a later stage of development this peripheral layer takes on the structure of true erectile tissue and forms the peripheral portion of the glans in the adult. Free anastomosis takes place between the spongy body and the peripheral layer of the glans, while the vascular connections with the cavernous bodies are small and insignificant.

**Coverings of the Penis.**—The coverings of the penis are disposed in four layers. From without these are: (1) skin; (2) dartos; (3) areolar tissue; (4) fascia of the penis. The skin covering the penis differs from the general body integument in its freedom from fat, the absence of smooth muscle fibers, the rudimentary character of its sebaceous glands, and the absence of hair except at or near the base. It is remarkably mobile, and after puberty is pigmented, resembling the skin of the scrotum. Extending beyond the glans it folds back on itself, forming a hood-like covering of the glans, called the prepuce. The inner semimucous layer of this duplicature is closely adherent to the neck of the penis and passes forward intimately covering the glans, to meet the mucous membrane of the urethra at the meatus. A triangular fold, the frenum, attaches the prepuce to the glans just below the meatus. Tearing or rupture of the frenum is often accompanied by severe hemorrhage from the frenal artery, which is controlled only by ligature. This artery must also be tied whenever the frenum is severed during circumcision. The two layers forming the prepuce are separate and distinct, thus permitting obliteration of the preputial sac and uncovering of the glans by retraction of the skin. Numerous glands on the inner layer of the prepuce, particularly about the frenum and coronary sulcus, secrete a white cheesy material, smegma, with a characteristic offensive odor.

Immediately beneath the skin is a layer composed of smooth muscle fibers continuous with the dartos of the scrotum. The fibers run for the most part longitudinally, others have an oblique direction. This layer extends forward to the preputial orifice, and follows the inner layer of the prepuce as far as the neck of the penis. These fibers, by their contraction, are supposed to assist in erection by producing stasis in the superficial veins.

Beneath the dartos is a layer of loose areolar tissue rich in elastic fibers. Within this layer run the superficial vessels and nerves. It is to this layer that the skin owes its extreme mobility. Its loose texture favors the excessive accumulation of fluids seen in massive edema of the penis.

The sheath of the penis, already referred to as Buck's fascia, is composed almost exclusively of elastic tissue. It forms the common sheath of the erectile bodies to which it intimately adheres. It is attached posteriorly to a triangular bundle of fibers, the suspensory ligament of the penis, which surrounds the penis and is inserted into the symphysis pubis, and to the superficial perineal fascia. Anteriorly it is inserted into the base of the glans. It is this disposition of Buck's fascia which protects the cavernous bodies from invasion in ulcerative lesions of the glans, and also by confining periurethral inflammation and cellulitis within its limits for a long time protects the glans from involvement.

**Muscles.**—The paired muscles of the penis are the ischiocavernosus, or erector penis, and the bulbocavernosus or accelerator urinæ. The ischiocavernosus arises from the tuberosities of the ischium, and running obliquely forward and upward is inserted into the lateral fascial covering of the corpora cavernosa. By their contraction they compress the cavernous bodies and thus aid in erection. The bulbocavernosus arises from the central tendon of the perineum, and passing forward and inward completely surrounds the bulb. By its forcible contraction the fluid, urine and semen, which collects in the bulbous urethra, is expelled, thus assisting in the muscular effort concerned in ejaculation and in expelling the last drop of urine. Both muscles are innervated by branches of the internal pudic nerve and receive their blood supply from the branches of the internal pudic artery.

**Vessels.**—The dorsal arteries of the penis, terminal branches of the internal pudics, pierce the suspensory ligament, and running along the dorsal surface beneath the fascia of the penis (Buck's fascia), on either side of the deep dorsal vein, terminate in anastomosing branches about the corona glandis. These two arteries supply the coverings of the penis and give off branches to the corpora cavernosa. External to the dorsal arteries and the dorsal nerves courses the external pudic branch of the common femoral artery. This also supplies the integuments of the penis. The artery to the bulb, a branch of the internal pudic artery, pierces the anterior layer of the triangular ligament close beside the urethra and enters the bulb. It supplies the erectile tissue of the corpus spongiosum. The artery of the crus, also a branch of the internal pudic, pierces the anterior layer of the triangular ligament close to the ramus of the pubis and enters the crus. They furnish the main blood supply to the corpora cavernosa. In detaching the crura from the bone in the operation for the complete removal of the penis, the close proximity of these arteries to the bone may give rise to difficulty in controlling hemorrhage. It will be noted that the arteries of the penis supplying the erectile tissue and the envelopes are all branches of the internal pudic, except the small external pudic branches of the common iliac, which supply blood to the envelopes only.

**Veins.**—The veins of the penis are divided into a superficial and a deep venous network. The superficial veins situated in the subcutaneous tissue and collecting the blood from the integument unite to form the superficial dorsal vein of the penis. This passes back to the root

of the penis, anastomoses with the venous network of the abdominal wall and empties into the saphenous vein. The deep veins comprising the branches from the erectile tissue, and situated beneath the fascia of the penis, unite to form the deep dorsal vein of the penis. This vein forms the main venous trunk of the penis and, passing back, between the two layers of the triangular ligament, bifurcates and empties into the prostaticovesical plexus or plexus of Santorini.

**Lymphatics.**—The lymphatics of the penis, like the veins, are divided into a superficial and a deep network. The superficial system drains the prepuce, skin and subcutaneous tissue. Some unite to form a common trunk, the superficial dorsal lymphatic trunk, which empties into the superficial inguinal glands. Others maintain their independence and empty separately into the inguinal glands. The deep lymphatics, like the deep veins, lie beneath the fascia of the penis. They drain the glans penis and communicate freely with the lymphatics of the prepuce and the urethra. Running along the groove of the dorsum of the penis as a single or as multiple (2 to 4) trunks, they form a plexiform network in front of the symphysis, at which level one sometimes encounters two or more small glands. According to Cuneo and Marcille the deep lymphatics empty for the most part into the deep lymphatic glands along the femoral and iliac arteries and only exceptionally into the superficial inguinal glands. This course and termination of the lymphatics is important to bear in mind in the operation for carcinoma of the penis, which disease practically always involves the glans first. It is necessary not only to remove the superficial inguinal glands on both sides along with the nodes in front of the symphysis, but also the deep glands along the femoral vein, under Poupart's ligament and the retro-iliac glands.

**Nerves.**—The nerve supply of the penis is extremely rich, receiving filaments from both the cerebrospinal and the sympathetic systems, the former supplying the integument while the latter pass to the erectile bodies. The glans is particularly rich in nerves which terminate in free extremities and in special nerve endings, the genital nerve corpuscles of Krause. The erectile bodies receive filaments from the hypogastric plexus through the nervi erigentes which accompany the arteries to the cavernous and spongy bodies.

### CONGENITAL MALFORMATIONS.

Congenital malformations of the penis, as a whole, are extremely rare. They have little clinical interest and are referred to merely as curious errors of development. They are usually associated with developmental defects of other organs, as the bladder, kidneys, ureters, and rectum. Congenital deformities of one or more of the constituent parts of the penis are, on the contrary, relatively common, and certain of these represent well-known types; for example, hypospadias, congenital phimosis. The penis may be double, absent, concealed, twisted, adherent, or cleft.

**Double Penis.**—Double penis, penis duplex, diphallus verus, is an extremely rare anomaly but by no means as rare as generally supposed. Lebrun<sup>16</sup> recently collected 13 cases of double penis with double urethra and omitted 4. About double that number, including all cases of this anomaly, have been recorded. Several varieties have been described: supernumerary glans, 3 cases; double glans with a single shaft, diphallus partialis, 3 cases; and two separate well-developed penes. These are either superimposed, placed side by side, or separated for a greater or less distance. The two urethras are separate and distinct, communicating with a common bladder, or they unite in the prostatic region (Küttner's case<sup>15</sup>). In 4 cases the bladder was double,



FIG. 113.—Velpeau and Gorre's case.

and each urethra opened separately into the bladder of the corresponding side. In the frequently quoted case of Alan P. Smith<sup>29</sup> a stone formed in one of the bladders and was successfully removed. This man could void from either bladder at will. One of the most remarkable and widely known cases occurred in the person of Jean Battista dos Santos, a native of Faro, Portugal. He was exhibited at several European clinics, where a minute examination and accurate description of the malformation was made. In addition to two well-developed penes he presented a deformed supernumerary lower extremity projecting between the normal thighs. A wax model of the penile malformation is in the Army Medical Museum at Washington. (A description of this interesting case together with photographs by Mr. Hart

will be found in *Lancet*, London, 1865, ii, 124.) Curious variations in the functions of the two organs have been observed. In 13 cases urine was voided by both urethras, Ollsner's patient<sup>24</sup> voided through the right and ejaculated through the left penis. Two patients (Niemann,<sup>22</sup> St. Hilaire<sup>28</sup>) passed both urine and semen by both urethras. In 2 cases with imperforate anus, feces and urine escaped together. Keppel<sup>14</sup> observed that the right penis of his patient was used for urination only, while the left was the only one capable of erection under excitation.

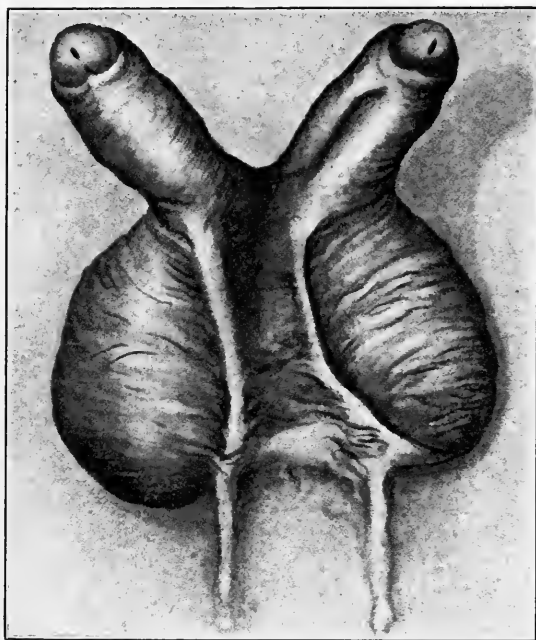


FIG. 114.—Lange's case.

Reduplication of the penis never occurs alone, but is always associated with other marks of fetal inclusion. A number of cases have been observed in children who presented other abnormalities incompatible with life, such as imperforate anus, and it was for the relief of this condition that they came under observation. In adults the condition is nearly always discovered accidentally during examination for some other unrelated malady. It is probable, therefore, that this abnormality is not as rare as the number of cases reported would indicate, since these unfortunates are careful to guard their secrets and do not come under observation except when compelled to by necessity. Other abnormalities associated with reduplication of the penis are double bladders, hernia, and exstrophy of the bladder, cleft scrotum, imperforate anus, and hypospadias. Volpe's<sup>32</sup> case is unique; this infant

with imperforate anus had a double penis, urethra, bladder, and scrotum, with a single (horseshoe) kidney and a single ureter opening into the left bladder, a fusion of the organs normally double and a reduplication of the organs normally single.

**Treatment.**—Surgical intervention, except in rare cases, is limited to the treatment of associated malformations requiring operation. In 2 cases an operation was performed for atresia of the anus; 1 (Coles)<sup>8</sup> was successful. In a favorable case an accessory penis can be removed, as was done by Lioni<sup>17</sup> and Albrecht,<sup>2</sup> with very good chances for excellent functional results. Except in these rare instances surgical treatment is of no avail, and therefore not indicated.

**Absence of the Penis.**—Congenital absence of the penis is exceedingly rare, and unlike reduplication, is not accompanied by other gross malformations of the external genitals or developmental defects in other parts of the body. This condition must not be confused with concealed or apparent absence of the organ, or with pseudohermaphroditism. The penis is completely wanting, the urethra opens upon the perineum or on the anterior wall of the rectum. The subjects of this deformity are in other respects normally developed with well-marked secondary, sexual characteristics. The scrotum is normal, the testicles are present, but not pendant. The extreme rarity of this anomaly is evident from the fact that only 7 cases have been recorded. Harris<sup>11</sup> collected 5, added 1 of his own but omitted 1 (Revolat). I have not been able to find any others reported since. It is curious that the earlier literature contains no mention of this anomaly. There were two infants, the others were adults, and in three of these the urethra opened into the rectum. Mathews's<sup>13</sup> patient, a man, aged thirty years, had been married several years. His secret was known only to his mother and family physician previous to marriage. He died of kidney infection following a simple operation for hemorrhoids. In two adults with the urethra opening into the bowel the kidney did not become infected.

**Concealed Penis.**—In cases of apparent absence, the penis is dwarfed and concealed beneath the skin of the scrotum or perineum. This condition is easily mistaken for that of true congenital absence. Careful search, however, will reveal a rudimentary organ concealed beneath the skin. Cases have been described by Chopert, Bouteillier, and more recently by Mocquot, and Aievoli.<sup>1</sup> In Mocquot's<sup>20</sup> case, a man sixty-one years of age, the scrotum was normal and both testicles present but not pendant. In the normal position of the penis there was a depression surrounded by a fold of skin, in the depth of which a cylindrical body could be felt. This was a rudimentary penis, 7 cm. long and about the size of one's little finger. In the case recorded by Aievoli the penis was covered completely, even the glans, by the skin of the scrotum.

**Treatment.**—The treatment consists in the liberation of the penis by incision and in supplying a covering of integument from the adjacent parts by an appropriate operation.

In the newborn with retention resulting from this deformity, liberation of the penis by dissection must be done at once; the plastic operation may be deferred until later, as was done by Aievoli.

**Torsion.**—Torsion of the penis or twisting in its long axis may occur. The frenum then comes to occupy a mid-dorsal position. It is usually associated with hypospadias, epispadias, or other penile defects. Cases have been reported by Jacobson. Very rarely this deformity exists alone and independent of any other deformity, as in Caddy's<sup>7</sup> case.

**Adherent Penis.**—Adhesions between the penis and scrotum together with marked incurvation occur as a complication of scrotal hypospadias. Freeing of these fibrous attachments and straightening the penis constitutes the first step in any operation for hypospadias. In the absence of any urethral defect the penis may be enclosed by the scrotal integument throughout its entire length. Such a case of webbed penis is described by Mummery.<sup>21</sup> More commonly the attachment of the scrotum extends forward along the under surface of the penis a varying distance, and may seriously interfere with coitus (*Verge palmé*). The treatment is simple, and consists in severing the attachments as far as necessary and suturing the loose skin in the corrected position.

**Cleft Penis.**—There is only one case of transverse cleft or splitting of the glans on record. This singular abnormality is described by Hofmokl<sup>12</sup> in a man, aged sixty-eight years, with congenital phimosis. Retracting the prepuce it was discovered that the glans was divided by a deep transverse cleft into a thickened dorsal and a thinner ventral portion. The urethra opened in the midline at the bottom of the deep sulcus. There was a shallow, blind opening on the inner surface of the lower segment. This man had been married twice and was the father of eight children.

A vertical cleavage of the glans would appear to be more common, but nevertheless extremely rare. When complete, a double glans results (see above). Trenkler<sup>30</sup> has recently observed a remarkable case of cleft penis in a strong, healthy young man without any other congenital defect. The appearance was that of a double penis in which the left one was rotated slightly under the other. Examination showed that in reality the condition was not that of duplication, but that a vertical cleft involving the corpora cavernosa and the urethra separated the two bodies completely. By drawing the two halves wide apart the urethral opening could be seen at the bottom of the sulcus. On the inner aspect of either half, extending from the urethral opening to the tip, was a narrow band of mucous membrane. These presented numerous pits or lacunæ, and represented the lateral walls of the cleft urethra.

**Hypospadias and Epispadias.**—Hypospadias is a congenital defect of the anterior urethra, the canal terminating at some point behind the normal position of the meatus. This defect varies in degree from a mere elongation of the meatus to a complete absence of the urethra in

front of the perineum. It never extends beyond this point, hence the posterior urethra escapes, the sphincters are competent, and the patient is always able to control his urine. Eleven varieties of hypospadias have been described, but for practical purposes it is necessary to distinguish only three, which are, in the order of their frequency of occurrence, balanitic (glandular), penile, and perineal (perineoscrotal). In balanitic hypospadias the urethra opens just behind the glans at a point where the frenum, which is absent, is normally attached. The glandular urethra is either entirely wanting, or there may be a shallow groove, or a deep furrow, lined by mucous membrane which represents the roof of the fossa navicularis. The glans is generally broader than normal, somewhat flattened, and slightly incurved. The malformed prepuce forms a redundant hood-like fold on the dorsal aspect of the glans. This degree of hypospadias causes little inconvenience or interference with function and therefore seldom requires treatment other than the occasional dilatation of a contracted urethral opening.

In penile hypospadias the deformity is much greater. The urethral opening may be situated at any point along the floor of the penile urethra, but is usually just behind the glans, midway between the glans and scrotum, or at the penoscrotal juncture. Associated deformities are much more common in this variety and usually are more marked the greater the degree of hypospadias. When the hypospadiac opening is in the anterior portion of the penile urethra the penis may be well formed and its functions quite normal, but in penoscrotal hypospadias the member is usually small, malformed, and markedly incurved upon the scrotum to which it may be partially adherent. The corpora cavernosa are poorly developed. The urethra in front of the abnormal opening is most often obliterated and when an attempt is made to straighten the penis this stands out as a tense fibrous cord. Exceptionally it may remain patulous up to the meatus, end in a cul-de-sac, or in a secondary fistulous opening.

Perineal hypospadias represents the extreme grade of the deformity and is fortunately very rare. The associated malformation of the external genitals is most marked. The scrotum is divided by a deep cleft, each half containing a normal testicle, more often an atrophied testicle, or, when these have been retained, none at all. In any case the cleft scrotum closely resembles the vulva, the two halves representing the labia majora. The penis is dwarfed and may be completely concealed, except for the glans, by a redundant fold of scrotal tissue, and is easily mistaken for an hypertrophied clitoris. The urethral opening forms a funnel-shaped depression lined by mucous membrane and concealed under the retracted and incurved penis. Occasionally the urethra may continue forward to its tip as a groove on the under surface of the stunted penis. In a pronounced case it may be very difficult to determine the sex of the individual. The functions of the penis are little disturbed in balanitic hypospadias. The stream of urine may be very small on account of the contracted opening, or scattered and directed to one side or downward as a result of the associated penile

deformity. In the penoscrotal and perineal variety, function is markedly interfered with. Coitus is difficult or impossible, and sterility is the rule. In urinating, the patient must sit down to avoid wetting his clothes; the urine bathes the adjacent parts which become excoriated and eczematous.

**Etiology.**—Hypospadias is manifestly a congenital defect and is due to an error in development. The posterior, penile, and glandular urethra develop separately. At one stage in its development the urethra is an open gutter or groove, the sides of which unite in the median line to form the floor of the canal. If for any reason the process is arrested at any point, or the separate portions fail to unite properly, closure is incomplete and hypospadias results. The causes underlying the arrest of development are not well understood. The condition is unquestionably hereditary. Kaufmann<sup>13</sup> has proposed an ingenious theory to explain hypospadias and its accompanying deformities. He assumes that there is a failure of the separate portions to unite properly which results in atresia of the urethra. When the kidneys begin to secrete, the urine ruptures the urethral floor behind the point of occlusion and hypospadias results.

**Treatment.**—In the treatment of hypospadias one aims to correct deformities and restore normal function. Whether an operation should be advised or not depends upon whether the degree of deformity and the resulting disturbance of functions are sufficient to demand surgical relief. In balanitic hypospadias operation is rarely, if ever, indicated. The deformity is so slight that the disturbance in function is trivial and does not justify any surgical operation. Two operative procedures have been described, those of Duplay and of Beck.

*Duplay's Operation for Glandular Hypospadias.*—This operation is well adapted to cases in which there is a groove on the under surface of the glans representing the glandular urethra. The edges of this groove are freshened and brought together in the midline over a retention catheter by interrupted sutures of fine silk or chromic catgut. When the flaps are too short to come together without undue tension, lateral incisions into the glandular tissue are made which will overcome this difficulty. The retention catheter is retained until complete healing takes place.

*Beck's Operation.*<sup>4</sup>—This procedure is said to be suitable for cases in which the hypospadiac opening is just at the margin of or just behind the glans and the latter is not grooved on its under surface. A circular incision is made about the hypospadiac opening and this is extended laterally on either side along the sulcus behind the corona. A longitudinal incision is then made, beginning at the hypospadiac orifice and extending along the line of the urethra. The two skin flaps thus marked out are dissected up. The urethra is then mobilized by dissecting the spongy body free from its bed for a certain distance. The glans is now tunnelled by passing a long narrow-blade scalpel from behind forward through the glans, emerging at its summit. This tunnel must be enlarged by dilatation or crucial incision. A pair of Kocher

forceps are now passed through this new meatus, the end of the liberated urethra seized and drawn through the tunnel. The dislocated urethra is sutured in place by interrupted sutures passing through the edge of the urethra and glans. The operation is completed by approximating the skin flaps to cover the raw surface. The distance the urethra is dissected free depends upon the amount of forward dislocation necessary. The urethra should not be under any considerable amount of tension when sutured in its new position, otherwise retraction will occur and the result will be a failure either from the sutures giving way or from a pronounced incurvation of the penis. Indeed, the tendency toward the latter deformity seems to be one of the chief objections to an otherwise theoretically ideal operation. The technic is slightly modified when the glans is grooved as shown in Figs. 115, 116, 117 and 118. My personal experience with Beck's operation in a small number of cases has been 100 per cent. failure, due to recontraction of the dislocated urethra and incurvation of the glans. A. C. Wood, of Philadelphia, has reported a similar experience. I am of the opinion that the procedure of Beck is faultily conceived for the repair of a defect which should rarely, if ever, be subjected to surgical attack. This operation as well as the preceding one can be carried out in one stage.

In penoscrotal and perineal hypospadias an operation is always indicated and its object is twofold: to straighten the penis and reconstruct the urethra. A number of operations have been described and performed which differ in the ingenious methods advised for the repair of urethral defects. The different procedures are all modifications of two fundamentally different methods, namely, urethroplasty by tunnelling, and by the use of flaps. The operations of Nové-Josserand, Rochet, and Mayo are examples of the first. While those of Duplay and Beck represent the second method.

The first step in all operations, and common to all, is to straighten the penis. A transverse incision is made through the fibrous band which holds the penis retracted and incurved on the scrotum. At times multiple incisions must be made to completely free the penis. It may be necessary to carry this incision into the sheath of the cavernous bodies, care being taken not to injure the latter, and if the spongy body is too short and interferes with complete liberation of the penis, it should be dissected up and allowed to retract. All constrictions having been divided, the penis is fully extended and the incision closed by transversely placed interrupted sutures. It is maintained in an extended position by appropriate dressings until healing is complete. At the time of the straightening of the penis Pousson advises straightening the glans by his technic of "redressement." A transverse V-shaped wedge of tissue is removed from the dorsal surface just behind the glans. When the edges of the wound are sutured, the incurvation of the glans is overcome.

One should wait from four to six months after the first stage before beginning the plastic repair of the urethra in order to be sure no further retraction will occur and to allow the scar tissue to become freely movable.



FIG. 115.—Beck's operation for hypospadias. (Watson and Cunningham.)



FIG. 116.—Beck's operation. (Watson and Cunningham.)



FIG. 117.—Beck's operation. (Watson and Cunningham.)



FIG. 118.—Beck's operation. (Watson and Cunningham.)

*Duplay's Operation* (Pousson's technic<sup>26</sup>).—In this operation the urethral defect is repaired by flaps taken from the penis itself. This operation or a slight modification is the one most generally used.

*First Stage.*—Begins by straightening the penis as already described.

*Second Stage.*—A preliminary perineal section is done to divert the urine through a perineal fistula. This is absolutely essential to the success of any operation for hypospadias. An incision is then made on the under surface of the penis parallel to its long axis about 8 mm. from the midline and extending from the summit of the glans to the level of the hypospadiac orifice. At each extremity of this incision, incisions *AC* and *BD* are made at right angles extending outward a distance of 6 mm. The flap *E* thus outlined is then dissected up toward the outside. Shorter incisions (*AF*, *BG*) mark out a narrower, inner flap (*H*).

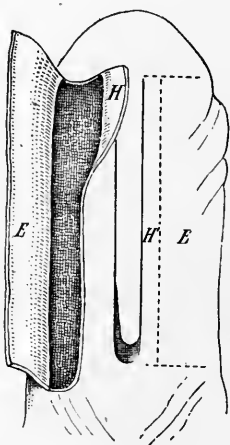


FIG. 119

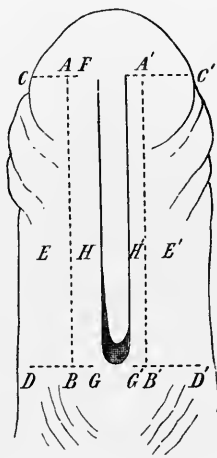


FIG. 120

FIGS. 119 and 120.—Duplay's operation for penoscrotal hypospadias. (Pousson's technic.)

Similar flaps are made on the opposite side of the midline, an outer and an inner, with this difference, that the longitudinal incision is only 5 mm. from the midline and the inner flap (*H'*) is therefore narrower. The two flaps (*H* and *H'*) are sutured together over a catheter and form an inner layer on the floor of the new urethra. As these two flaps are of an unequal width, the suture line will be at one side and therefore not directly under the outer suture line. Flaps *E* and *E'* are then brought together to cover in the raw surface and form the outer layer of the double urethral floor.

*Third Stage.—Closure of the Perineal Fistula.*—Drainage of the bladder through the perineal opening should be maintained until complete healing has taken place and one is sure that displacement of the flaps due to faulty suturing or infection will not result in the formation of a fistula. The perineal fistula is then closed in the usual way.

*Beck's Operation.*—This operation makes use of flaps derived from the penis and scrotum. On either side of the midurethral line and several millimeters distant a longitudinal incision is made extending from the summit of the glans to just beyond the level of the abnormal urethral opening. These are joined by transverse incisions at either extremity.



FIG. 121.—Beck's operation for scrotal hypospadias. First step. (Watson and Cunningham.)

The flap thus outlined is dissected up on either side and the edges brought together over a catheter in the midline by interrupted sutures, thus forming a urethra with an epidermal lining. A flap is now marked out on the scrotum with its base at the abnormal urethral opening of proper shape and size to cover in the raw surface left by the first flap.

This is rotated on its base and sutured in place over the new urethra. The scrotal wound is closed by direct suture (Figs. 121, 122 and 123).

*Nové-Josserand's Operation.*<sup>23</sup>—This is the best-known procedure in which urethroplasty is made by tunnelling and the use of grafts. The results obtained by the technic originally described were unsatisfactory,

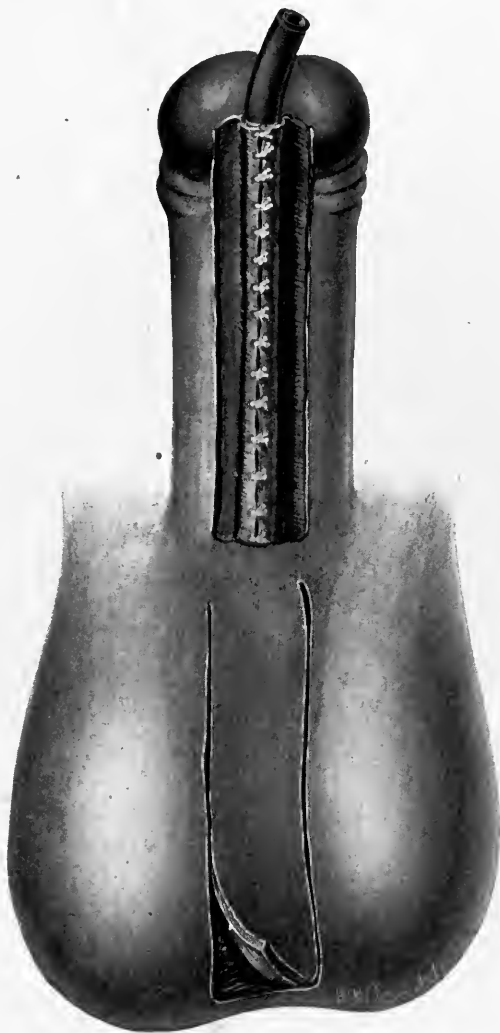


FIG. 122.—Beck's operation for scrotal hypospadias. Second step. (Watson and Cunningham.)

as a fistula at the juncture of the new-formed and normal urethra was practically constant, and the new canal showed a marked tendency to contract. This technic was subsequently modified and the results obtained by the originator of the operation have been recently fully analyzed.

*Step One.*—The urine is diverted by a perineal urethrostomy, the edges of the urethra being sutured to the skin. Redressement of the penis is then made. At the same time the hypospadiac urethral opening is excised together with 2 or 3 cm. of the urethra, a ligature placed



FIG. 123.—Beck's operation for scrotal hypospadias. Third step. (Watson and Cunningham.)

about the stump and the wound in the penile urethra sutured (Figs. 124 and 125). The penis is immobilized against the abdominal wall by appropriate dressings and one waits for two or three months.

*Second Step.*—This consists in tunnelling the new urethra and applying the graft. A trocar is introduced through the urethrotomy wound,

directed along the course of the proposed new urethra and brought out at the position of the new meatus. This tunnel is enlarged by special instruments. A dermo-epidermal graft is taken from the inside of the thigh, an area free from hair, this is wound spirally around a staff and fastened at either end by catgut ligatures. The staff carrying the graft is now introduced into the tunnel from behind forward and fastened into position (Figs. 126, 127 and 128). At the end of about eight days the staff is removed and after an interval of about three or four weeks bougies are passed to dilate the channel. It has been found that contraction will occur, and to overcome this an internal urethrotomy

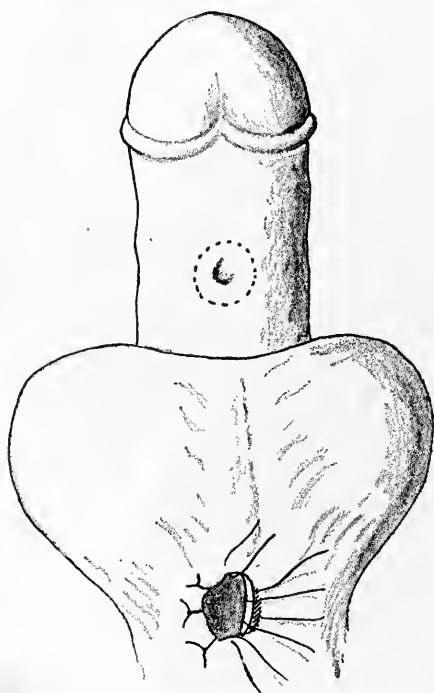


FIG. 124. — Nové-Josserand operation for perineal hypospadias. Formation of perineal fistula. Incision around hypospadiac opening.

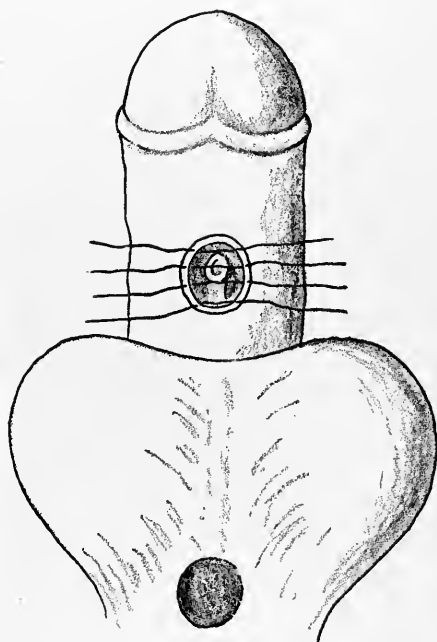


FIG. 125. — Nové-Josserand operation for perineal hypospadias. Excision of hypospadiac opening. Sutures in place.

is done after two or three months, just as is done for a stricture in an otherwise normal urethra.

*Third Step.*—This comprises the closure of the perineal fistula by the usual technic. The operation of Nové-Josserand is suitable for perineal hypospadias as well as penile.

*Rochet's Operation.*—Rochet<sup>31</sup> has proposed the transplanting of a skin flap taken from the scrotum in place of the graft used by Nové-Josserand, while Mayo and Donnet<sup>9</sup> each have described a technic of transplanting a flap taken from the redundant prepuce in cases of penile hypospadias.

In the plastic repair of urethral defects the transplantation of a section of vein or ureter has been suggested. Tanton has successfully experimented on dogs and more recently operated on a patient, using the saphenous vein for the transplantation. This procedure has also been used by Tuffier, Potel and Leriche, Becker, Stettiner and Schmieden. It is probable that this method of urethroplasty eventually will come into more general use. It must be said, however,

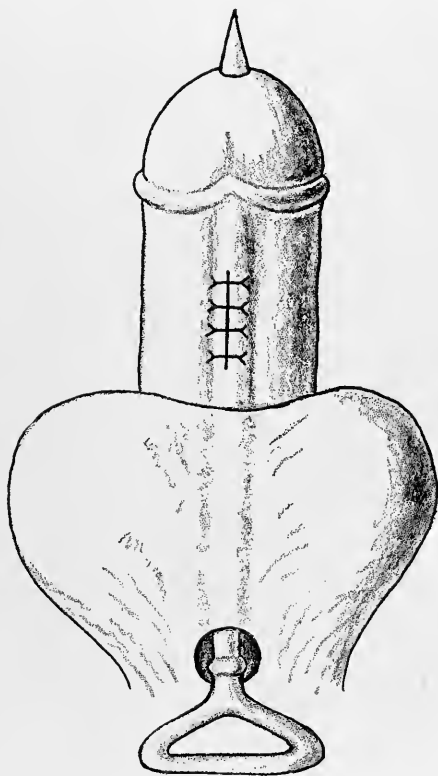


FIG. 126. — Nové-Josserand operation for perineal hypospadias. Hypospadiac opening closed. Formation of new urethra by tunnelling with a special instrument.



FIG. 127.—Nové-Josserand operation for perineal hypospadias. Preparation of graft. This is wound spirally around a catheter and anchored at either end by ligatures.

that any operation for hypospadias is difficult, due chiefly to the failure to get primary union. A fistula often results from infection and breaking down of the wound, which may require a long time and repeated efforts to close. Great care and gentleness in handling the tissues is necessary for success. Preliminary perineal drainage is indispensable. At what age should operation for hypospadias be undertaken? In cases of marked deformity this should be corrected early, otherwise development will be seriously interfered

with. About the sixth year is the most suitable time for the first step. It is better, according to Albarran, to wait several years, until the parts are fully developed before attempting the plastic repair of the urethra, about the sixteenth to eighteenth year. According to the experience of some other surgeons, better results are obtained when the operation is completed before puberty.

**Epispadias.**—In this deformity the urethra lies above the corpora cavernosa in the mid-dorsal line and the roof of the canal is partly or wholly absent. It is relatively rare. In the department of the Seine one case of epispadias was found in 6000 recruits, while Marshall did not find a case in examining 60,000 conscripts. Baron observed 300 cases of hypospadias for two of epispadias. Three degrees of epispadias occur: balinitic, penile and complete, or penopubic. In the balinitic form the urethra opens upon the upper surface of the glans or at the level of the coronary sulcus, the glandular urethra being represented by a groove. In penile epispadias, which is very rare, the urethra opens farther back on the upper surface of the penis and extends forward as a groove to the tip of the glans. Complete epispadias is characterized by complete absence of the roof of the urethra and is nearly always associated with exstrophy of the bladder and separation of the pubic bones. In these cases the penis is deformed; it is short, broad, and generally curved upward against the pubes. The urethral opening is large, infundibuliform, often admitting the examining finger. It is usually concealed by an overhanging fold of pubic tissue above, and below by the penis, which is strongly curved upward against the opening. The prepuce is divided and is redundant on the under surface of the glans. In balanitic epispadias the functional disturbances are less marked. Coitus is usually difficult on account of the brevity of the penis, and the stream of urine is spattering. In the more marked

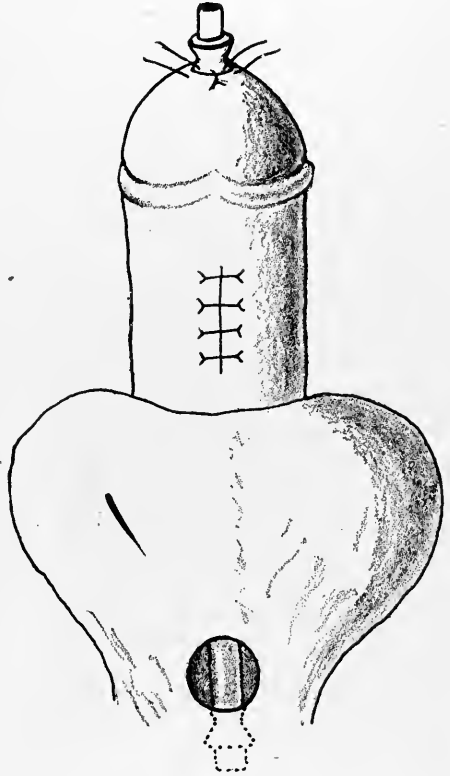


FIG. 128. — Nové-Josserand operation for perineal hypospadias. Introduction of graft into the newly formed canal, made by transfixing the tissues.

cases the associated penile deformity makes coitus impossible, while the constant dribbling of incontinence renders the condition of these unfortunates well-nigh intolerable. Incontinence of urine, absent in some cases of most marked epispadias, is partial or intermittent in others, and is always absolute when the posterior urethra is involved. In the latter case there is usually a separation of the pubic bones and exstrophy of the bladder, or hernia without exstrophy.

**Etiology.**—This condition is obviously due to arrested development whereby complete closure of the canal does not take place. No satisfactory explanation, however, has yet been offered as to how or why the urethra comes to lie above the corpora cavernosa. The very rare cases of complete separation of the cavernous bodies with the urethral opening situated in the angle between them really represents an intermediate stage in the migration of the urethra from its normal position to that occupied in epispadias.

**Treatment.**—The treatment is either palliative or radical. Palliative treatment consists in devising some sort of apparatus, which the patient wears constantly, for collecting the urine. The irritation of the urine continually bathing the parts, the odor, and the leakage makes this form of treatment unsatisfactory and insupportable. The surgical treatment of epispadias is difficult, tedious, and requires time, patience, and skill. Several successive operations, separated by a considerable interval of time are required, and a successful result is often delayed by the formation of fistulæ which are difficult to heal. As in the treatment of hypospadias, the preliminary step in any operative procedure consists in establishing drainage through a perineal fistula and the redressement of the penis. Having secured perineal drainage through a perineal fistula, time should be allowed for complete healing of the eczematous condition usually present, before attempting to straighten the penis. This latter is accomplished by severing all constricting bands and bandaging the penis to a splint in the extended position. Several methods have been described for the repair of this urethral defect. The procedure of Duplay is the simplest. The edges of the urethral canal are freshened and brought together by suture over a sound. This simple urethrorraphy is suitable for those cases only where the urethral groove is deep and the edges can be approximated without undue tension.

In Thiersch's operation the new urethra is constructed of flaps taken from the penis, prepuce, and pubic region.

**First Step.**—The penile urethra is formed of flaps taken from the penis itself. The method has been already described under Duplay's operation for penile hypospadias, which was adapted from Thiersch's operation.

**Second Step.**—After several weeks or months one proceeds to reconstruct the glandular urethra. This is done by freshening the edges of the glandular urethra and suturing over a sound.

**Third Step.**—This consists in the repair of the deformed prepuce. A transverse incision is made at the base of the prepuce, and through this

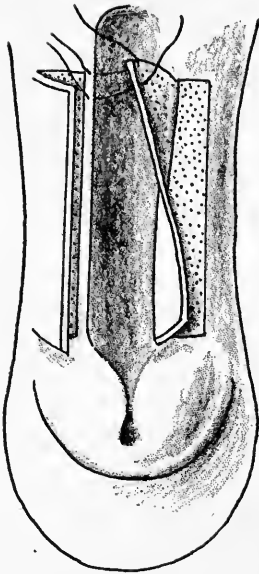


FIG. 129.—Thiersch operation for epispadias. Dissection of flaps and first row of sutures.

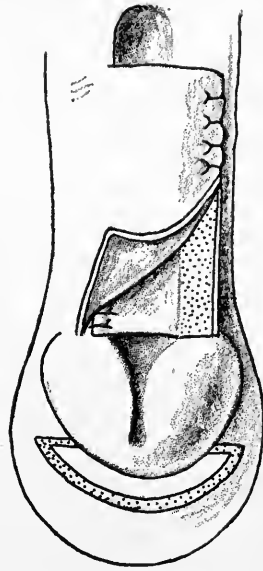


FIG. 130.—Thiersch operation for epispadias. Flaps sutured in place, incision of prepuce.

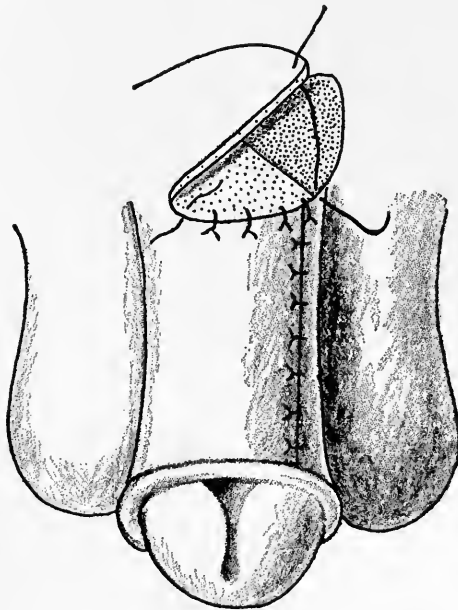


FIG. 131.—Thiersch operation for epispadias. Prépuce drawn over the glans and sutured in place. A flap from the pubic region covers the pubic opening of the newly formed canal and the raw surface is covered by suturing.

opening the glans is drawn. The cuff of prepuce, thus transferred to the dorsum of the glans, is sutured in this position to a freshened area and serves to cover any fistula remaining between the balanitic and penile urethra.

*Fourth Step.*—The epispadiac opening remains to be closed by flaps taken from the pubis. The method of employing these flaps is shown in Figs. 129, 130 and 131. Nové-Josserand has employed his technic for the repair of hypospadias in these cases of epispadias with excellent results.

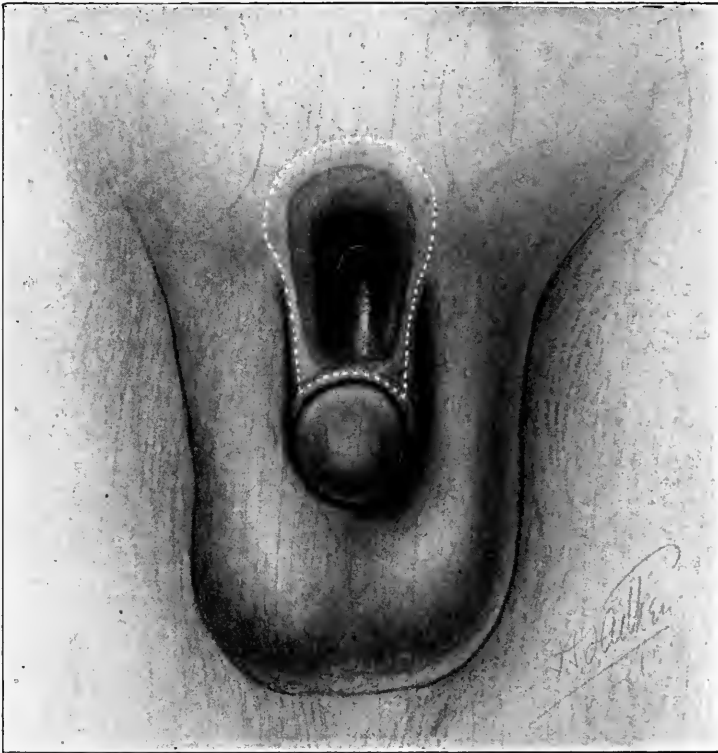


FIG. 132.—Beck's operation for epispadias. First step. (Watson and Cunningham.)

*Beck's Operation<sup>5</sup> for Epispadias.*—In this ingenious operation the new urethra is formed of mucous membrane obtained by dissecting up the tissues about the infundibuliform urethral opening, and forming these into a canal which replaces the urethral defect. The floor of the new urethra is made by dissecting up the floor of the urethral groove, the dissection beginning at the coronary sulcus, and extending back to the vesical orifice. The roof of the urethra is formed from the tissue above the urethral opening. The incision is shown in Fig. 132. The flap thus outlined is dissected up in the same manner as dissecting out

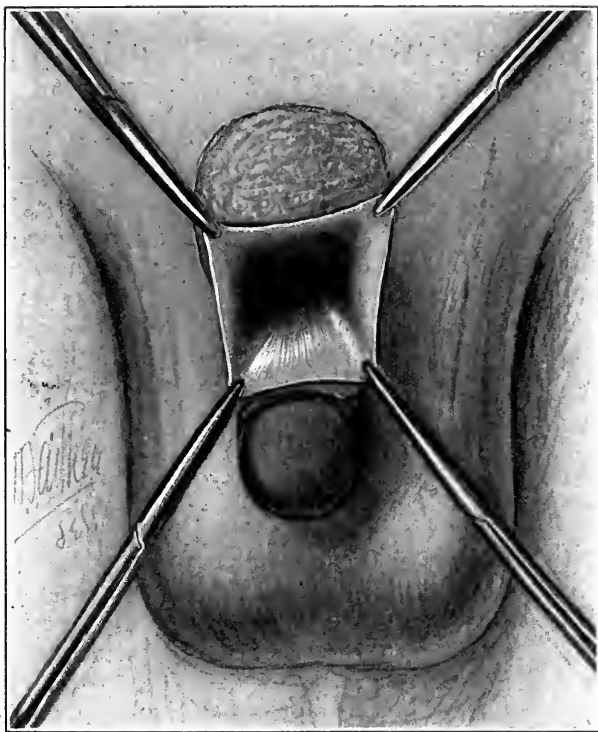


FIG. 133.—Beck's operation for epispadias. Second step. (Watson and Cunningham.)

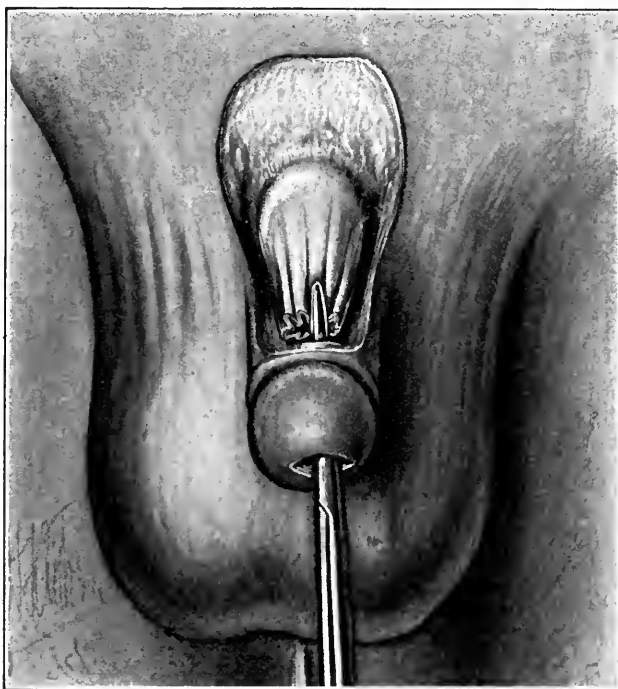


FIG. 134.—Beck's operation for epispadias. Third step. (Watson and Cunningham.)

a hernial sac, with the left index finger introduced into the urethral opening. In this way one avoids buttonholing the flap. Care must also be taken in making the incision to allow a flap long enough to extend to the tip of the glans without undue tension. The two flaps which are to form the roof and floor of the new urethra are now sutured along their edges into a tube Fig. 133. The glans is then perforated and the end of the new urethra is drawn into this opening and sutured to the margin of the new meatus Fig. 134. The raw surfaces are covered in the usual manner. In suitable cases the operation is relatively simple and avoids the formation of fistulæ so troublesome in the flap operation of Thiersch. The result in one case by the author of the method was most satisfactory. This patient was able to retain his urine for four hours.

### WOUNDS AND INJURIES OF THE PENIS.

**Contusions.**—Contusion of the penis is characterized by excessive edema and the extravasation of blood into the loose subcutaneous areolar tissue, and is the result of the application of direct violence without resulting lesion of the skin. Such injuries are rare and occur when the penis is erect, the flaccid organ generally escaping. They result from any common accident, as a blow, a fall, the kick of a horse, the passage of a wagon wheel, etc. In a personal case the patient was struck by an ear of corn thrown by a companion in play. In the curious case of Dufour, the young man while seated, with his penis erect, received a young woman roughly on his lap. In another case (Voillemier) the man caught his penis in closing a bureau drawer. Dupuytren records the case of a drunken man who had his penis caught under a falling sash while urinating out of the window.

The amount of hemorrhage into the tissues depends upon the extent of the injury. This may be slight, amounting to little more than a subcutaneous ecchymosis, or it may be abundant and simulate gangrene. In one case (Solignac) the dorsal vein was wounded on the edge of the corsets during coitus, producing an abundant hemorrhage, difficult to arrest. If the sheath of the cavernous bodies is injured, hemorrhage may be very abundant. If the urethra is wounded, there is always hemorrhage from the meatus, and the condition is a much more serious one.

**Treatment.**—This consists in the application of hot, moist compresses and a supporting bandage to keep the penis elevated. Absorption takes place rapidly, the edema subsides and the discoloration disappears. When a hematoma forms and is developing rapidly, an incision should be made to evacuate the blood and ligate any bleeding-point or suture any laceration requiring it. If suppuration occurs, this must be treated by free drainage. Injury to the urethra is more serious and calls for appropriate treatment to prevent extravasation of urine and the formation of a stricture. (See Injuries of the Urethra.)

**Wounds.**—The penis may be wounded accidentally in a great variety of ways; it may also be wounded maliciously, as in injuries inflicted through jealousy; or intentionally, as for example, the self-mutilation practised by certain sects and by insane patients. These wounds are usually classified as punctured, incised, lacerated, and those resulting from fire-arms.

**Punctured Wounds.**—Punctured wounds are very rare, and are caused by bayonet, sword, or foil thrusts. In a case described by Demarquay the injury was due to a fall on a spike. Malgaigne saw a curious case in which an open knife carried in the pocket severed the dorsal artery of the penis.

**Incised Wounds.**—Incised wounds are most often seen as the result of self-mutilation by insane patients or criminal mutilation inspired by jealousy. One recalls the custom of the barbarous Abyssinians, of emasculating their enemies when captured, and the practice among the adherents of the cast of Skoptzy of cutting off the penis. Accidental injuries of this kind are rare; the case of Nottingham is an exception. A young sailor received a deep wound of the glans during intercourse from a piece of a glass nozzle which had broken off in the vagina while taking a douche.

**Lacerated Wounds.**—These result most often from the bite of an animal, for example a horse, dog, hog, etc. Less often they are produced by machinery. Westbrook's<sup>33</sup> patient was caught in a pulley which tore the skin from the pubis, scrotum, and penis. In Powers's case, a lad of six years, the injury occurred in climbing over a barbed-wire fence. The skin of the penis was stripped off, turned inside out, and hung at the preputial attachment. The nature of the wound depends upon the manner in which it was produced. It may be limited to the integument which is lacerated, torn, and turned inside out like the finger of a glove, as in Powers's<sup>27</sup> case, or the deeper structures may be implicated. According to Biondi,<sup>6</sup> less force is necessary in the production of lacerated wounds when the penis is erect than when it is flaccid.

**Gunshot Wounds.**—These are by no means rare. They are usually associated with injuries to other organs, the bullet passing through the penis or finding lodgment here after passing through neighboring structures. In the Civil War Otis recorded 30 cases. When the cavernous bodies are pierced, hemorrhage is abundant and a large hematoma may result. The scar remaining after healing will interfere with erection.

**Treatment.**—In the treatment of wounds of the penis one is guided by the general surgical principles applicable to wounds of other parts. Cleanse the wound and apply an antiseptic dressing. Hemorrhage should be controlled by ligating the bleeding-point or by suture of the torn sheath of the corpora cavernosa. When suppuration supervenes, free incision and drainage are demanded. Healing of wounds of the penis is rapid, owing to the abundant blood supply. Even in apparently hopeless cases an attempt should always be made to save the organ,

and amputation is resorted to only when every effort has resulted in failure. In one case we obtained a useful organ when this seemed to be hopelessly gangrenous. When the urethra is involved in the injury, this should receive immediate attention to prevent extravasation of the blood and urine and the subsequent development of a traumatic stricture. When the urethral wound does not communicate with the surface, a retention catheter, if this can be introduced, may be all that is necessary. Open wounds of the penile urethra require closure by suture, and the drainage of the urine through a perineal fistula will be found necessary in most cases for a successful healing of these wounds.

**Rupture of the Penis.**—The terms rupture and fracture of the penis are used to designate the same lesion, namely, a tear in the fibrous sheath of the corpora cavernosa. Strictly speaking, fracture of the penis in man does not occur, since there is normally no bone in the penis. Among certain animals, as the bull and the sea lion, there is an os penis, but fracture of this bone is not observed. Calcification sometimes occurs in cases of circumscribed cavernitis or Peyrone's disease, and true bone tissue has rarely been found as a pathological product in the human penis, as in Gerster's case.<sup>10</sup> Rupture of the penis always occurs during erection and is usually due to sudden rough bending of the penis downward toward the thighs. It results from a false pass in coitus, masturbation, or a direct blow. In Mott's case this accident was due to striking the erect penis against the bed-post. Merkens<sup>19</sup> describes an unusual case in which complete transverse subcutaneous rupture of the corpus spongiosum was produced by accidental closing of an open door through which the patient was urinating. It is probable that the sudden increase in pressure during erection produced by a blow or sudden bending of the penis is sufficient to rupture the normal fibrous sheath of the erectile bodies, hence the accident plays the chief role. In some cases, however, the corpora cavernosa and their fascial coverings are weakened by areas of degeneration resulting from antecedent disease, and are therefore much more easily ruptured. At the time of the accident there is sudden pain at the point of rupture, a distinct crackling sound is heard, the penis becomes flaccid, and coitus is interrupted. In a short time the penis begins to swell from the associated edema and attains enormous proportions. The acute pain gives way to a sense of fulness; the penis is bent sharply at the site of the tear toward the uninjured side, hence the rupture is always on the convex side. Under appropriate treatment the swelling quickly subsides; the ecchymosis gradually disappears, but a scar often results which interferes with erection and may make coitus impossible. Suppuration rarely occurs, and hemorrhage is not often alarming.

**Treatment.**—Elevation of the penis and the application of cold compresses suffices in most cases. Incision and suture are rarely required, but should not be deferred when indicated by a progressive hematoma.

**Dislocation of the Penis.**—In this exceedingly rare accident the body of the flaccid penis is forced out of its outer sheath of integument and displaced under the skin of the scrotum, pubes, or thigh. The

injury has been observed in children as well as adults. The mechanism of its production is not clear from the cases reported, but evidently the body of the penis is squeezed out of its envelope by a force applied to its outer extremity, the separation occurring at the preputial orifice or more commonly along the coronary sulcus. The deformity is not apparent at first, since the skin sheath, filled with a blood clot, may present a normal appearance. Very soon, however, difficulty in urination attracts attention and examination shows a sheath filled with blood and containing no penis. The urethra is usually ruptured in the perineum and extravasation of urine with its attending symptoms may supervene. Careful search will always reveal the presence of the organ in its abnormal position.

**Treatment.**—In at least two cases (Nélaton and Guth) the penis was easily replaced in its sheath, with happy results. This may be difficult or impossible, however, owing to the edema and infiltration, in which case incision will be necessary to liberate the penis and permit its reposition in its proper sheath. In the event of a rupture having occurred, immediate perineal section will be necessary.

**Strangulation of the Penis.**—This injury is not at all uncommon. It is seen in children as the result of a nurse tying a string or cord about the penis to prevent the escape of urine in cases of incontinence. In adults, strangulation is produced by rings, bands, the neck of a bottle, etc., used for the purpose of masturbation or other sexual perversions. The extent of the injury will depend upon the degree of constriction, the amount of swelling of the penis, and the length of time the foreign body is allowed to remain. As a result of the constriction, the penis swells rapidly and the constricting band is buried at the bottom of a deep groove; it is soon hidden from view and may be difficult to find. The injury will vary from a superficial lesion of the skin in the simplest case to section of the urethra and even gangrenous destruction of the distal portion of the organ. With the onset of swelling, retention of urine is complete and is relieved only by removal of the foreign body. When this is delayed, the urethra ruptures behind the constriction and a fistula results. It is the pain associated with the swelling and especially the retention of the urine which compels the patient to seek relief, which he usually does in a few hours. Shame and fear of detection may delay the visit to a physician and the patient postpones seeking relief for a longer time; three weeks, six months, a year, or even twelve years in reported cases. The treatment consists in removing the foreign body as soon as possible. This is easily done in the case of a thread or a thin ring. When the foreign body is a thick ring its removal may require considerable patience and ingenuity. In Aylen's<sup>3</sup> case it required two hours to file through a heavy iron ring. When the urethra has been cut into, the resulting fistula must be closed according to the principles laid down in the section on Injuries of the Urethra.

## BIBLIOGRAPHY.

1. Aievoli: Arch. gén. de méd., Paris, 1906, ii, 2380.
2. Albrecht: Ztschr. f. Path., 1910, iv, 475.
3. Aylen: St. Paul Med. Jour., 1905, vii, 46.
4. Beck: New York Med. Jour., 1898, lxxvii, 147.
5. Beck: New York Med. Record, March 30, 1907.
6. Biondi: Jahresbericht f. Urog., 1906, p. 251.
7. Caddy: Lancet, 1894, ii, 634.
8. Cole: Nashville Med. and Surg. Jour., 1894, lxxvi, 159.
9. Donnet: Bull. et Mém. de la Soc. de Chir. de Paris, 1906, xxxii, 1002.
10. Gerster: Ann. Surg., 1913, lvii, 896.
11. Harris: Philadelphia Med. Jour., 1898, i, 71.
12. Hofmokl: Arch. f. klin. Chir., 1897, liv, 220.
13. Kaufmann: Deutsche Chirurgie, L, a, 60.
14. Keppel: New York Med. Jour., 1898, lviii, 710.
15. Küttner: Beit. zur klin. Chir., 1895-6, xv, 364.
16. Lebrun: Journal d'Urologie, 1912, ii, 380.
17. Lioni: Deutsche med. Wehnschr., 1914, xl, 393.
18. Matthew: Quoted by Harris.
19. Merckens: Deutsche Ztschr. f. Chir., 1911, cxi, 313.
20. Mocquot: Bull. et Mém. Soc. Anat. de Paris, 1904, lxxix, 344.
21. Mummery: Rep. Soc. Study Dis. Child., London, 1906-7, vii, 99.
22. Neimann: Quoted by Lebrun.
23. Nové-Josserand: Lyon Méd., 1897, lxxxv, 198.
24. Ollsner: Quoted by Lebrun.
25. Papadopoulos: Thèse de Lyon, 1908.
26. Pousson: Ztschr. f. Urologie, 1914, viii, 440.
27. Powers: Ann. Surg., 1909, xlix, 238.
28. St. Hilaire: Quoted by Lebrun.
29. Smith, Alan P.: Transactions Med. and Chir. Faculty of Maryland, April, 1878.
30. Trenkler: Wien. med. Wehnschr., 1914, lxiv, 1079.
31. Trillat: Arch. prov. de Chir., 1902, p. 311.
32. Volpe: Il Policlinico, fasc., 1903, i, 46.
33. Westbrook: Long Island Med. Jour., 1911, v, 405.

## CHAPTER VII.

### DISEASES OF THE PENIS.

By GEORGE W. WARREN, M.D.

#### DISEASE OF THE FRENUM.

A SHORT frenum, which may be classed as congenital, occurs in cases where there is no other malformation. This may interfere with complete emptying of the urethra. It may cause an incurving of the penis when the organ is erect. I have seen cases where the subject was sterile, due to this marked incurving, and became fertile by simply cutting through the frenum. During coitus these short frenums are torn and the accident frequently results in a marked hemorrhage, the frenal artery being torn. Sexual neurasthenia in some cases is caused by these short frenums. Erections are very painful.

**Treatment.**—Cutting through the frenum, and sewing together the cut edges of the wound, which causes a quicker union and prevents hemorrhage, as the frenal artery is caught by the stitch.

#### PHIMOSIS.

**Congenital Phimosis.**—The opening or ring of the foreskin in this condition is relatively to the glans so small that retraction of the foreskin over the glans is impossible. There are necessarily several degrees of this condition, from those cases where the meatus of the penis is seen with difficulty or not at all to those where the foreskin can be retracted, but the blood supply of the glans by this act is cut off or impeded.

In the newborn there is a physiological phimosis which continues for a longer or shorter time. The inner leaf of the foreskin, that portion in contact with the glans, is adherent to it by an epithelial deposit. This condition can be relieved by separation with an instrument or retraction of the foreskin. If this condition is allowed to remain, inflammatory processes supervene and result in adhesions between the glans and foreskin. As the patient grows older this physiological phimosis is relieved by the orifice of the foreskin becoming larger at about the second year, and it generally takes the adult form between the years of nine and thirteen.

The normal foreskin can be retracted over the glans easily and painlessly when the penis is in erection, and when there is no retardation of blood circulation while it is thus retracted.

Congenital phimosis may exist with a prepuce of normal length or

with one very long or short. In cases of long prepuce the glans is covered with an empty sac which lies in folds. Upon urination this bag fills with urine and may balloon out to the size of an egg, and the urinary stream issuing has little force.

The opening of the foreskin may be so small that a fine probe cannot enter it. In these cases the frequent ballooning of the foreskin causes it to become tremendously dilated. This great dilatation causes a disproportion between the outer and inner leaf of the foreskin. The ring of the foreskin, which is the narrowest portion of the same, seems to be retracted by the overhanging of the outer leaf.

In cases of short foreskin (atrophic phimosis) the prepuce is drawn tightly over the glans. Here, again, the opening of the prepuce may be very small and not in line with the meatus. This causes difficulty in urination and may be a serious condition.

In both of these conditions, long and short foreskin, there may be an accumulation of epithelial smegma and urinary sediment, preputial stones, and balanoposthitis may occur. These are not, as one would expect, constant sequelæ of this condition. In both of these lesions, when the condition has existed for some little time, there is sometimes a trabeculation of the bladder and at times a hydronephrosis with dilated ureters.

The urinary act is always difficult, and, as before stated, in those cases of short foreskin where its opening does not correspond to the meatus, the child strains and cries with pain upon urination. The long foreskin may hold urine and dribble after the urinary act. At times the urine retained in the foreskin becomes infected and decomposes, and the resulting inflammation may cause urinary retention.

In adults phimosis with short foreskin results in a poorly developed glans penis, and the sexual act is interfered with. Many of these cases are sexual neurasthenics.

Retention of urine may sometimes occur in these cases of phimosis, when upon this condition balanoposthitis is superimposed. All the complications of a balanoposthitis are to be found in these cases of phimosis, such as erosion, ulceration and perforation of glans and foreskin, stone formation under foreskin, and ammoniacal urine.

The dangerous sequela of impediment of urination, in cases of phimosis, is often underestimated. In cases of marked phimosis of children it is not uncommon to find hernia, prolapsed anus, etc., due to the marked abdominal pressure necessary to empty the bladder.

**Phimosis in Adults:** The impediment of urination exists, though not so apparent as in children. Dwarfing of the glans penis; sexual neurasthenia may be conspicuous in these cases; balanoposthitis with its complications is common; and most important is the danger of cancer formation. Three-fourths of all cases of cancer of the penis reported occur in cases of phimosis.

Preputial stones may be a complication of phimosis. They generally

occur in children, but rarely in adults. Two types of stone may exist in phimosis: true preputial stones which are formed under the prepuce, and stones which are formed in the kidney or bladder, and in their escape from the body are caught in the preputial sac by its narrow ring.

True preputial stones are formed from the smegma, epithelial detritus, bacteria, and the salts of decomposed urine. They are light in weight, soft, brownish bodies without any characteristic shape, often being so soft that they mould themselves over the glans, even to the extent of covering it. When the number of stones is large they may be faceted. Generally they are small in size, but there are exceptions, one being reported the size of an egg. They are multiple, as a rule; as many as a hundred have been reported. Under the microscope they are seen to consist of epithelium, fat molecules, cholesterin crystals, urinary salts, and bacteria.

The hard, heavy stones sometimes found in this location are formed in the kidney or bladder. They often gain in size by the accumulation of smegma and epithelial deposits from the foreskin. Under this layer of smegma and epithelium is found as a nucleus a urinary stone. This nucleus will show the elements of a true bladder or kidney stone.

These stones, as a rule, cause a chronic balanoposthitis, often accompanied by a thick, purulent secretion. The penis may be swollen and edematous, and the prepuce infiltrated. The patient may suffer from dribbling of urine or difficulty in urination, and may have frequent erections and pollutions. Often they suffer from defective erections, due to pain. Usually these patients are not aware of the presence of a stone, although they often feel a foreign body under the foreskin which at times impedes urination by wedging itself into the ring of the foreskin. The stone tends to ulcerate through the foreskin in long-standing cases, resulting in fistula formation. There is danger in these cases of bladder and kidney infection.

**Treatment.**—Circumcision.

### PARAPHIMOSIS.

Paraphimosis embraces all conditions in which the glans penis is compressed or strangulated by the prepuce. This takes place when the glans penis passes forward through a comparatively small preputial ring and the ring in sliding back over the glans drops into, and is held by, the sulcus back of the corona.

Paraphimosis can exist only in cases in which there is a relatively moderate degree of phimosis, and the length of the foreskin must be sufficient to allow it to slip back behind the corona.

It is impossible for paraphimosis to exist in cases in which the foreskin cannot be drawn back over the glans, as in cases of high-grade phimosis, or in cases of very short frenum, or where adhesions exist between the glans and foreskin.

This lesion occurs, as a rule, when the penis is erect. It can take place with the penis flaccid, but is then usually accomplished by forcibly pulling a tight foreskin back over the glans.

As the inner leaf is closely adherent to the shaft of the penis for some little distance back of the corona, one will readily see that the preputial ring cannot be in direct apposition to the shaft of the penis, but is separated from it by this layer of the inner leaf. Only in cases of atrophic phimosis, where the inner leaf hugs the glans closely, does the entire foreskin come back so that the preputial ring lies in direct apposition to the shaft of the penis.

In cases of milder paraphimosis there is only a swelling of the glans penis, and behind this is the folded and swollen outer leaf of the prepuce. The preputial ring lying in the sulcus is hidden under this swelling of the outer leaf. The swelling of the glans is, as a rule, far more marked, and it becomes edematous and discolored. Behind, and at times overlying it, is the swollen outer leaf. In the sulcus, and more than filling it, is a second swelling, consisting of the swollen and edematous inner leaf. Only by lifting aside this second swelling can the preputial ring be seen.

A long or short frenum may modify the character of a paraphimosis. A long frenum may cause the constriction of the preputial ring to occur behind the sulcus.

The sequelæ of this condition are rapid swelling, discoloration, and bullæ of the tissue, which may go on to necrosis. This takes place just in the region of greatest pressure. Gangrene of the ring is rare. The gangrenous process generally confines itself to the outer and inner leaf, sparing the cavernous tissue.

Paraphimosis may relieve itself somewhat by gangrenous process of the preputial ring. There are cases reported in which by numerous inflammatory processes and ulcerations the preputial ring has been enlarged, thereby relieving the tendency to constriction.

The systemic symptoms are mild, patients often not presenting themselves for treatment until the condition has existed for several days.

**Treatment.**—In most cases the swollen glans can be compressed between the fingers until it can be pushed back through the ring. When this cannot be done the constriction should be relieved by incision of the preputial ring. Circumcision may be performed after the swelling has subsided.

### SUBCUTANEOUS INJURIES OF PENIS.

Pain may be very intense even in slight injuries, and may cause the patient to faint. The bleeding following these contusions is very noticeable, even in superficial contusions, and the resulting ecchymosis spreads over the pubic region, scrotum and perineum, as well as the shaft of the penis.

The discolorations of skin due to this deep extravasation of the blood appear in a cherry or blue red, while the subcutaneous extravasation

appears as a dark blue. This extravasation, as a rule, spreads from the deep to the superficial coverings of the organ, and extends over a large area. The point of most marked extravasation is the point of greatest induration. Subcutaneous tearing of the penis involving the corpora cavernosa takes place only when the penis is erect or when the corpora cavernosa are involved by inflammation, causing a tightening of the connective tissue. Formerly this was called fracture of the penis. This is not a true fracture, as sometimes happens in lower animals, in which an os penis exists; but in man a growth of bone occurs only as a rare pathological condition. So-called fracture is a tear of the cavernous tissue. This tear, as a rule, extends through the albuginea (the fibrous covering of the cavernous body), which, when the penis is flaccid, is over 2 mm. in thickness and very tough, and when the penis is erect, is spread out to a thinness of 0.25 mm. (Henle). The force causing the injury, as a rule, is delivered in line of the long axis, rarely in the transverse. The injury is rare during coitus, but may take place if the organ strikes outside the vaginal orifice. It is more often due to a blow by a falling body or the pushing of the penis against some foreign body, or by forcibly bending back the organ. So-called fracture may result when the patient tries forcibly to correct the deformity resulting from chordee, in which case it is almost always limited to the corpus spongiosum.

**Symptoms.**—The symptoms of fracture are similar to those resulting from a grave injury to the urethra. Inability to void often exists when the urethra is not injured. This is due to the pressure on the urethra from blood extravasation. The absorption of the blood is rapid.

**Diagnosis.**—In this instance diagnosis is apparent. The deformity of the penis, as a rule, is corrected by the patient, but even in these cases where the deformity has been corrected one may feel the break in the albuginea and corpora cavernosa. At this point there is a marked induration and the blood clots creak under the touch. The pain is intense.

**Prognosis.**—The prognosis depends upon the presence or absence of complications. In some cases the blood is quickly absorbed from the parts and the blood spaces of the cavernous body are freed. In these cases the function of the penis remains normal. In other cases this does not take place and a hard infiltration remains in the cavernous body. This causes either a crooking of the penis or else that part of the organ in front of the fracture remains flaccid when the organ is erect.

If, as a complication, we have an infection, gangrene and partial loss of the organ may result.

**Treatment.**—In cases in which the urethra is not involved, a simple dressing with a splint is sufficient, care being taken to have a free passage for the urine. Where the extravasation is absorbed slowly, or the blood clot becomes infected, drainage becomes necessary.

## OPEN WOUNDS OF THE PENIS.

Tearing and contusions are more often the cause of open wounds of the penis than biting, shot, cut, or stab wounds.

The most common tearing wound is of the frenum; also the tear of the prepuce in cases of phimosis is common. In rare cases the whole organ is torn off, as where the parts have been caught in machinery, etc. It is rare to have the skin torn from the organ, but it does occur. In these cases the skin is stripped from the root of the penis and rolled up forward.

*Luxatio penis* is a condition which is frequently described, though not common, but the resulting condition is of serious consequence. The skin of the penis is torn through at the inner leaf of the foreskin at the sulcus coronalis and the denuded penis is liable to slip back from its skin envelope and is lost under the skin of the scrotum or pubis. These cases, as a rule, are due to violence, but may follow ritual circumcision. The condition resembles the so-called congenital anomaly (*phimosis scrotalis*) in which the penis lies under the skin of symphysis pubis or scrotum. The patient directly after the accident presents a short skin sac, often filled with blood clot, which can be easily emptied by pressure. It is sometimes difficult to find the shaft of the penis. The urine is emptied either through the skin sac or from some neighboring skin wound. Urination is necessarily interfered with and as it takes the path of least resistance the tissues may become infiltrated. After a short time the shaft of the penis becomes fixed in its abnormal position by scar tissue.

Wounds in which a portion of the skin has been stripped off, and even when there is loss of tissue, heal readily and rarely lead to death. Nevertheless, the resulting scars often cause contractions and the distorted penis may be of little value functionally.

**Treatment.**—Fresh wounds of the frenum should be sutured immediately with fine thread. The stitch should include the frenal artery. In older cases which have been infected it is better to clean the part and treat by wet dressings before plastic work is begun, as the swelling which is always present will by these means be reduced and thus the ultimate result is better.

The so-called *luxatio penis* should be reduced at once, the denuded penis placed in the skin sac and held by loose stitching. Urinary fistulæ should be excised freely and drained, and the whole covered by wet dressing.

As a rule these cases require several operations before a satisfactory result is obtained. In those of long standing in which the shaft has been caught and held by scar tissue in its abnormal position one finds great difficulty in locating it. The guide, naturally, is the existing urinary sinus, as it must lead to the meatus of the penis. Thus one opens these sinuses freely and dissects back to the hidden shaft. After the shaft is quite freed it is placed in its skin envelope as in fresh cases.

Healing in these instances is usually good, except when infected or neglected.

In those cases in which the skin has been torn it should be united by stitches at once. Drainage should be instituted in those where there has been marked maceration or when a great amount of dirt has been driven into the wound. When there is loss of tissue, plastic work should be instituted at once, as the resulting scars of neglected cases cause marked distortion of the penis, which can be corrected only with the greatest difficulty.

Contusions of the penis are similar to subcutaneous contusions already described, but are of greater intensity, and often involve the scrotum and perineum. They are accompanied by shock. The prognosis of contusions depends upon how early the case is seen and upon the absence or presence of complications, such as infiltrations and scar formations. When there is injury to the urethra a catheter should be passed into the bladder and retained there. There should be an immediate attempt to repair all wounds.

Wounds of the penis resulting from bites are usually severe and are due to attacks by animals. Insect bites are serious only as the resulting swelling and infection may lead to gangrene of the part.

### **BURNS AND FREEZING OF THE PENIS.**

Burns are treated as elsewhere on the body.

Freezing of the penis is very rare. The symptoms are the same as for other parts of the body. The scratching of the patient, due to the intense itching, may cause an infection and consequent chronic inflammation. There is, as a rule, a low-grade urethritis and balanoposthitis in these cases. The part is afterward sensitive to cold and heat, as is seen in cases of frozen ears.

### **STRANGULATION OF PENIS BY FOREIGN BODIES.**

This is not a very rare condition, and is due to the application of ligatures or other encircling bodies. Hair is the most common, and with children is sometimes applied by the mother or servant with the belief that it will stop bed-wetting. When ligatures are used by older people, which is rather common, they are used with the idea of increasing erection or to prevent nocturnal pollutions.

Many tubular articles are used by the weak-minded and masturbators. There is a large variety of these instruments. They are applied to the penis before or during erection, and are at times removed with the greatest difficulty, as the constriction of the enveloping instruments allows ingress of arterial blood and obstruction to outflow of venous blood.

In my experience the ligature, especially the ligature of hair, is by far the most commonly met with. This ligature is generally applied just at the corona and soon causes a marked constriction. In a few days

it is rather a difficult matter to determine the cause of the strangulation, as the peripheral end of the penis becomes swollen and soon the ligature cuts through the skin and underlying connective tissue. The prepuce is inflamed by the resulting infections and takes on a markedly swollen, angry appearance. The edema makes it hard to find a hair ligature, even in an early case; but later, when it has cut into the tissues and is covered with granulations, it is most difficult. The constriction at this time, if a non-elastic ligature is used, is lessened, and a child may carry such a ligature for weeks. If not removed it is at times covered by scar tissue from the healing of the wound of entrance. It may then cause no further trouble and be carried thus in its connective-tissue retainer for years. If the ligature cuts into the urethra there is a resulting fistula.

Solid rings applied to the flaccid penis are firmly caught by the resulting erection. The penis becomes markedly swollen, due to the obstruction to the return flow of the blood. Gangrene of the tissue is the result. Systemic symptoms in these subjects are not marked.

### ACUTE INFLAMMATORY PROCESSES.

Edema of the foreskin accompanies all acute inflammatory affections and local mechanical interference with circulation. This mechanical interference may be due to a tight-fitting dressing, or ligature, or to constriction due to contraction of scar tissue. In cases of general edema of the organ it is more marked at the prepuce and most marked at the frenum. The under surface of the penis shows the least edema. Edema of the glans is first seen on its under surface in the line of the attachment of the frenum to the orifice of the urethra. When this edema continues the glans, being held firmly by the attachment to the frenum, can swell only on its upper surface, and this causes the demarcation of the glans and frenum to be obliterated. The edema is, as a rule, more marked on one side and then the organ is bent in the opposite direction. In cases of marked edema, urination at times is interfered with. After dorsal or lateral incision of foreskin, there often exists a chronic edema of the flaps.

Acute inflammation of the glans (balanitis) and foreskin (posthitis) are rarely separate and will be treated together as balanoposthitis. The most common form of this is due to gonorrheal infection.<sup>1</sup> Other infections are divided by some writers into catarrhal, croupous, diphtheritic, and diabetic. The diabetic is a complication of diabetes. All cases of balanoposthitis are due to filth, an irritating foreign substance retained under the foreskin causing inflammation. Men without a foreskin never have balanoposthitis, as the mucous membrane by exposure is converted into epidermis.

<sup>1</sup> Although gonorrhea is the exciting cause in this condition there are no gonococci in the secretion from the foreskin, the infection of the foreskin being due to another organism.

**Etiology.**—The cause is any form of irritation which may lead to inflammation of the mucosa of the glans and foreskin. The most common is the retention and decomposition of the secretion of Tyson's sebaceous glands; the accumulation of gonorrheal pus; the products of hard or soft chancroidal growth; and eczema or herpes of the glans and foreskin. To all these causes must be added uncleanness, as one never finds balanoposthitis when the parts are kept clean.

**Symptoms.**—The first symptoms are burning and itching. The foreskin soon becomes swollen, often to such an extent that it cannot be drawn back over the glans. There is an increased secretion, due to irritation. This may be of a purulent nature, and may be so profuse that it drops from the foreskin. The meatus, if it can be seen, appears swollen, as well as the lining of the foreskin and the covering of the glans penis. Lymphangitis is generally present. The dorsal lymphatics are outlined in red lines and are swollen and painful to the touch.

As this inflammatory process continues there is erosion of the epithelium covering the parts, which may lead to ulceration. In severe cases the foreskin, as a whole, is edematous and swollen, and if retracted over the glans penis and not reduced, may lead to gangrene.

Recurrence of balanoposthitis leads to infiltration and increase of connective tissue in the foreskin, which may be so great that it is impossible to retract it. Other complications are the formation of adhesions between the glans and foreskin, as well as preputial stones.

Balanoposthitis is more common in children, especially at time of puberty, and, as above stated, is due to lack of cleanliness. In older people, when phimosis is present, a large number will be found to have a keratosis, or so-called venereal warts. The danger of malignant changes in them is very great. (See Carcinomata.)

**Treatment.**—Remove the irritating agent and keep the parts clean. Circumcision is advisable in cases of phimosis after the inflammation has subsided. If erosions are present after circumcision, one had better use a salve with boric acid or one containing 0.5 per cent. silver nitrate.

As stated above, balanoposthitis is one of the complications of diabetes, and is often due to the sugar-charged urine remaining under the foreskin. This is a favorable medium for bacterial growth, and when this takes place the itching, edema, swelling, and increased secretion of Tyson's glands are present, as in uncomplicated balanoposthitis. These subjects having a reduced resistance against infection, the covering of the parts soon ulcerates and infiltration of the organ follows. The phimosis and scar retraction are often marked. The diagnosis is at once suggested by finding sugar in the urine.

**Herpes Progenitalis.**—Herpes progenitalis manifests itself in an eruption of blisters containing a water-like fluid. These blisters may be single or in groups. They occur usually on the retroglandular surface behind the sulcus, but may appear on the shaft of the penis. They have been reported as involving the urethra in their extension. These

water-like blisters soon become infected, and then their contents become white and cloudy. The breaking of the blister causes ulcer formation. The inflammation soon subsides and the ulceration heals. Often there is a painful inguinal adenitis as a complication.

Certain of these cases have neuralgic symptoms, as in herpes zoster. In these instances a day or two before the eruption there is marked pain and soreness to the touch of the skin of the penis and scrotum, the pain sometimes radiating to the glans penis. This symptom disappears as the vesicles appear.

**Treatment.**—Cleanliness, and a saturated solution of argyrol in ichthylol to paint over the eruption, and bandage with dry dressing.

Cause is unknown, although the vesicles seem to follow the nerve fibers. Cases show a marked tendency to recurrence.

**Erysipelas.**—Erysipelas of the penis is rarely primary. If primary, it is due to infection with a streptococcus through some abrasion in the penis.

### SKIN AFFECTIONS OF THE PENIS.

Skin affections in general may involve the penis and ought to be considered in connection with the original disease. The most common of the skin lesions occurring on the penis are psoriasis, scabies, herpes, a leukoplakia preputialis, described by Schuchardt, and venereal ulcers.

### PHLEGMONS OF THE PENIS.

Circumscribed inflammations of the penis are noted in connection with eczema, erysipelas, variola, typhus, and infectious diseases of severe type.

Although the above are to be mentioned, the majority of phlegmons are secondary to traumatism or to extensions from inflammatory processes in the urethra, also after urinary infiltrations, as well as after ulcerations, insect bites, erysipelas, etc.

These phlegmons may be accompanied by gangrene of the skin. In such cases the dorsal lymph channels are prominent and painful. There is a painful adenitis in the groin. Of the causes of this gangrene little is known.

**Symptoms.**—The condition starts in a typical manner. There is at first slight local pain and redness. In more severe cases vomiting and fever are early symptoms. The penis, and often the scrotum, are swollen. At the end of about twenty hours there appear numerous gangrenous spots on the skin. These quickly coalesce and total necrosis of the skin of the penis and scrotum results. This is not a deep-seated process, but at times results in abscesses of the parts. Often the lymph glands in the neighborhood suppurate and abscesses extend to the abdominal wall. In severe cases the gangrene becomes demarcated in a few days and the symptoms improve. Recovery is the rule, although rarely death occurs due to general sepsis.

**Treatment.**—Incision for drainage and wet dressings.

**Acute Cavernositis.**—Acute cavernositis, an infection localized in the cavernous bodies, must be differentiated from a superficial phlegmon.

**Etiology.**—Acute cavernositis is due to injuries, extravasation of urine into the cavernous bodies in cases of stricture and infected thrombosis which occurs in certain blood diseases, as leukemia.

**Symptoms.**—At the onset an irregular, hard, painful mass is felt which can be localized in the cavernous body. There is painful and, at times, difficult, urination, due to the extension of the process to the urethra. Suppuration soon occurs and then a fluctuating swelling takes the place of the hard mass formerly felt. In neglected cases the abscess may break into the urethra or through the skin of the penis. As stated above, traumatism and the complications of stricture are the causes of the infection. (This type of cavernositis is often spoken of as periurethral abscess.) But it may be hematogenous in origin, as it occurs in cases of septicemia.

**Diffuse Cavernositis.**—The rarer and much severer type of cavernositis, the so-called diffuse idiopathic cavernositis, is, in my belief, always hematogenous in origin and is due to pyemic metastasis. These patients rarely recover.

Diffuse cavernositis begins with marked systemic symptoms: chills, high fever and marked swelling of the prepuce. Priapism is a characteristic symptom and is present by the third day of infection. The erections may be complete or partial, may last for long periods and cause difficulty of urination. Priapism may be due to physiological irritation of cavernous bodies or to a thrombosis of the same. The latter is painless and is generally followed by gangrene of the penis. These infections at times go on to abscess formation and they may rupture into the urethra. Untreated cases of a few days' standing show symptoms of pyemia. Death is not uncommon. At autopsy the lungs, liver and kidneys contain abscesses. The penis may remain erect after death, held in this position by the thrombosis of the cavernous bodies. Cases which recover may have nothing of the penis left but a mass of scar tissue.

Cases have been reported of diffuse gangrene of the penis which is due to thrombosis of its bloodvessels. This thrombosis may extend from the iliac, femoral, and periprostatic veins.

**Chronic Cavernositis.**—Chronic cavernositis may follow acute cavernositis. In these cases scar tissue replaces that portion of the cavernous body which previously was the site of inflammation. Another group of these chronic cases never present any acute symptoms. The inflammatory process begins as a small, irregular swelling, generally on the dorsum of the penis and often near the symphysis. The masses vary in size, are generally small and may be multiple. There is a tendency for this chronic process to develop connective tissue. In this manner more or less of the cavernous body is replaced by connective tissue. This naturally causes a bending of the shaft when the organ is erect. The distortion, as well as the pain upon erection, may cause impotency.

Cases reported in literature of bony formation in the human penis are probably the calcification of these connective-tissue masses.

**Etiology.**—Causes are many—tearing of tunica albuginea, intra-cavernous extravasation, periurethritis, syphilis, and gout.

### GANGRENE OF THE PENIS.

Ordinary gangrene of the penis follows traumatism and inflammatory processes, as before stated. It also is caused here, as in other parts of the body, by loss of blood supply, burns, etc. Infiltration of urine with its resulting infection, deep-seated infections in the perineum are also peculiar causes of gangrene of the penis.

There is an acute progressive gangrene of the penis and scrotum described by Fournier, Kellemont and others, which occurs, apparently, without any specific predisposing cause and has no analogue in other organs. It may occur in persons suffering with diabetes, typhus and after cantharides poisoning. At times it occurs without any disease being present. It may follow bandaging of the penis after the bandage has been wet with urine, also after adhesive bands have been used on the penis to hold a retention catheter in the urethra.

**Treatment.**—Treatment is the same as for gangrene from other causes—incision and drainage.

### LYMPHATICS AND BLOODVESSELS.

Diseases of the bloodvessels and lymphatics are rare. Traumatic aneurysm of the dorsal artery, being the most common of these conditions.

### CARTILAGINOUS AND BONY FORMATION.

True bone formation is found in the penis of some of the lower animals. In man, thickened fibrous tissue takes the place of this bone. By careful examination this fibrous tissue can be felt normally.

Pathologically, in old people, the tunica albuginea may become infiltrated with a calcareous deposit, which resembles bone. The symptoms accompanying the condition are pain and distortion of the penis when erect. This distortion is similar to a chordee, with the concavity in the direction of the infiltration. Other causes than old age, held by some writers, are injury to the cavernous bodies involving the albuginea, chronic cavernositis, syphilitic lesions of cavernous body, and gout. There is doubt in the minds of many whether these latter so-called etiological factors can be proven. Undoubtedly, senility is the most common cause, as the pathological process in this location resembles senile processes in other parts of the body.

### TUBERCULOSIS OF THE PENIS.

Primary tuberculosis of the penis in adults is very rare. The glans is more often involved than the prepuce. It is a chronic process from

the start and manifests itself by the formation of granulation tissue, which gradually infiltrates the surrounding substance and may invade the whole thickness of the penis. This infiltrate undergoes caseation.

The infection may be acquired by coitus with a female having tubercular genitals or by direct infection with tubercular sputum. As the infection progresses, isolated masses can be felt in the cavernous bodies and urethra. They are often the size of a pea and as they enlarge they extend toward the surface and are felt directly under the skin. On section they are seen to be masses of caseous tubercles. Their growth is slow, but eventually the skin of the penis is involved with a resulting ulceration. In this state one may mistake the infection for a hard chancre. Although this infection is undoubtedly autogenous in the great majority of cases, the primary lesion may not be in the genito-urinary tract. The penis may be the seat of a secondary infection in cases where there is a tubercular infection of the kidney and bladder. These are rare, but when they occur, the meatus at first presents a swollen, angry appearance, and small miliary tubercles are seen over the surface. The adjacent tissue is slightly infiltrated. There is a seropurulent secretion. The whole picture is very much the same as that presented by the mouth of a ureter which has been infected by a tubercular kidney.

Tuberculosis of the penis in young children is far more common and is often due to direct infection at the time of circumcision by the rabbi.

The old, orthodox circumcision was performed by tearing the foreskin free from the penis by the finger-nail, and the resulting hemorrhage was stopped by sucking the penis with the mouth. This was at times performed by a rabbi with infected sputum. The incubation period in these cases is about two weeks. It manifests itself as a tubercle, being the typical yellowish or gray-white speck on a surface of granulation tissue. These infections progress rapidly; the inguinal glands are involved early. The patients always die either by a general tubercular infection or by marasmus. A few cases are reported where the wounds healed, but after two or three years death resulted from tuberculosis of some internal organ.

**Treatment.**—Although the tubercular organism is often not found in the tissue, one can, as a rule, demonstrate the organism if a deep section of the tissue is carefully stained. Excision or amputation of the diseased tissue is the safest procedure.

### GUMMA OF THE PENIS.

Gumma of the penis may be located in any of its anatomical divisions.

When located in the connective tissue just under the skin, it may have the appearance of an enlarged lymph gland, but as there are no lymph glands in the penis, one should be on one's guard. These masses are prone to break down, and may result in urinary fistula and stricture.

No pain accompanies this lesion.

**ACTINOMYCOSIS.**

This is a very rare pathological lesion. In the cases reported, pain is an early symptom, and there is a redness of the meatus which is soon followed by a serosanguineous secretion. In the accompanying induration there are small, purulent, knotty masses. These soon ulcerate through the skin so that the glans penis is covered with many small holes.

Amputation is the only treatment.

**ELEPHANTIASIS.**

True elephantiasis of the penis is due to infection with filaria. Naturally these cases occur in countries in which the disease is endemic. Here the only cases which have come to my notice are among emigrants. A great many were from St. Kits, West Indies.

The swelling may begin in the foreskin of the penis and then extends to the scrotum. The swelling of these parts, like other swellings incidental to the disease, is due to back pressure of the lymph on the parts, due to plugging of its channel which has been occluded by the mother worm. The chronic state of this lesion leads to a thickening of the skin and increase of connective tissue in the parts involved. This is such a rare condition in this country that the cause of the lesions may be overlooked. But, as a rule, by careful examination of the blood both by day and night, the young filaria will be found.

Several times each year cases present themselves which have all the ear-marks of true elephantiasis, even to the skin thickening and increase of connective tissue. The prepuce is often markedly swollen, and that part at the frenum stands out with great prominence. The most common cause of these cases is the complete destruction of the inguinal glands, generally by operative removal, or rarely by inflammation. In this way there is a lymph stasis.

Strictures, traumatism, syphilis, lymphangitis, as well as filth under the foreskin, all have been reported as causing this lesion.

If there is no ulceration or infection of the parts, these patients have no symptoms referable to the lesion, and their general health is not impaired. Ulceration and infection do occur rarely in very marked cases. The size of the organ causes a great deal of discomfort.

Amputation, or excision, including when possible all the tissue involved, has proved successful in some instances.

**EPITHELIAL CYSTS.**

In clinics which are attended by many Jews, cases at times are seen of epithelial cysts of the remaining foreskin. These are probably due to faulty method of circumcision. From the same cause, cases of tumor-like formation are seen where there has been poor union of the skin, and sebaceous glands have been turned under and in this position continue to secrete.

The secretions of the sebaceous glands at times are retained and cause small but oftentimes numerous tumors of the penis. These are situated more frequently at the hairy portion of the organ.

### DERMOIDS OF THE PENIS.

True congenital dermoid cysts have been reported. They never attain a large size, but contain the ordinary elements of dermoid cysts in other locations. They occur mainly near the raphe.

### TUMORS OF THE PENIS.

Papilloma of the penis is rare and there is some question if true papilloma does occur. Waldeyer reports a case of nineteen years' standing which was of a very large size. The tumor involved the inner and outer foreskin, as well as the shaft of the penis. He made the diagnosis of a true papilloma, as its elements did not involve the connective tissue.

Fibromata are rare and of little importance. The cases reported are of the neurofibromata type.

Chondromata are rarely seen on the penis.

Lipomata may occur in the skin.

So-called venereal warts (*condylomata acuminata*) are common. They are present in cases of congenital phimosis and those cases in which the glands at the corona are active and the patient does not keep the parts clean. The tumor masses are true epithelial outgrowths. Treatment is excision. These wart-like growths are prone to malignant degeneration.

**Carcinomata.**—Carcinoma of the penis is next to the most common skin cancer. It occurs usually at about fifty, rarely before forty years of age.

Congenital phimosis is an important etiological factor. The great majority of reported cases have, or have had, phimosis. Some cases have been published where the exciting cause was a wart, or syphilitic ulcer, and some authorities lay stress upon trauma or inheritance. Although the infective theory has been advanced, no cases have been proved where cancer of the penis has been acquired by intercourse with a woman having carcinoma of the cervix.

The classification of this newgrowth may be made from a clinical or pathological stand-point. Küttner divides them from a clinical stand-point into papillary cancer, carcinomatous swelling, and tumors not papillary, but adds that one type can pass into the other.

Pathologically, they are all epitheliomata and can, according to some pathologists, arise from the basic or squamous cells. This naturally divides cancer of the penis into two types. This theory is not held by many authorities.

The majority of these epitheliomata occur in the form of papillomata and involve, primarily, the glans or inner leaf of the foreskin. Its

papillæ are hard, leaf-like structures in contradistinction to the fine villæ seen in bladder papillomata.

The peripheral growth soon fills the space between the glans and prepuce, and by infiltrating the tissue of the foreskin, breaks through the preputial sac in one or more places. The glans which previously has been covered by the infiltrated foreskin which could not be retracted, may, after this perforation, be seen again. •

It is rare, even in cases of phimosis, to have the outer leaf of the foreskin the primary seat of a newgrowth. Small warty growths on the glans may give rise to neoplasm, either by their malignant degeneration or carcinoma may develop near them. The foreskin in these cases is soon distended by the swollen glans and cannot be retracted. This is due to the disproportion of the size of the glans and the foreskin, while in those cases where the growths occur on the foreskin the inability to retract the foreskin is due to the infiltration of the same. All newgrowths which are situated under the foreskin are soft and moist, but if uncovered, are hard and dry. The papillary branches spring from one stem, but this is often overlooked on account of the great mass of these branches. Like all epitheliomata, the surface cells tend to degenerate, filling the interstices with a white, smegma-like, foul-smelling paste.

These tumors may grow to be several times the size of the glans. The growth is often so rapid that large pieces are cut off from their blood supply, die and fall off.

The many ulcerations of the penis, caused by the infiltration of its tissue, lead to fistula, and where these enter the urethra, they discharge urine.

By the invasion of the penis by the growth and the subsequent death of this tissue the organ wastes away. A cauliflower growth perforated by many urine-delivering fistulæ, connected to the pubis by a short stem, the remains of the penis shaft, is often the condition of the patient when he presents himself for treatment. The whole penis is eventually sloughed off by the continuation of this process. The pubis and scrotum may be involved. The patient urinates through sinuses in the newgrowth, which connect with the eroded and shortened urethra.

Küttner describes a form of carcinoma which he says is rare. It appears as an ulcer with raised edges, either on the glans or at the sulcus. The growth is slow at first, but from the start the connective tissue of the part is involved.

The other form described by him he claims is the rarest and is characterized by a grayish-white discharge. It does not have a papillary structure and may become very large. The tissue of the tumor has a tendency to undergo cystic degeneration.

Newgrowths of the penis, by extension, may involve the scrotum, testicle, prostate, bladder, rectum, and pelvic cavity. The cavernous bodies are not involved early, as the albuginea offers an obstruction to invasion, but when involved there is an advance of the growth along the cavernous tissue. The inguinal glands are the first lymph glands

to be involved, then the retroperitoneal. Metastases are common, although they take place late in the disease.

**Symptoms.**—Carcinoma of the penis begins without pain. In cases in which a phimosis exists there is itching of the parts, and as ulceration takes place it is accompanied by a discharge which may be profuse. Urination may be impeded either by the newgrowth obstructing the outlet of the foreskin, or by ulceration of the urethra. As the condition advances, erections are painful and later disappear. Pain, when present, is due usually to the growth invading the glans. The advance of the growth is slow, as a rule, often a year elapses before the patient presents himself for treatment.

**Diagnosis.**—The diagnosis is difficult to make in early cases without microscopic sections of the tumor. It may be mistaken for a condyloma. The differential points are: condyloma tissue is soft and cancer is hard; the attachment of condyloma is superficial, while cancer is deep.

It is wise to make microscopic sections of the tissue in all cases. This is especially easy to do, as most cases have a phimosis which must be relieved when they present themselves for diagnosis.

**Treatment.**—Treatment is amputation with radical removal of the lymph glands, which drain the field of operation.

**Sarcoma.**—Sarcoma of the penis is very rare. It may occur as a round or spindle-celled tumor which infiltrates the tissue of the penis.

Myxomatous types are very rare, while the melanosarcoma are somewhat more common. These growths develop fast and the lymph glands are soon involved.

**Prognosis.**—The prognosis is very bad even in cases of early operation.

**Diagnosis.**—The diagnosis may or may not be hard, but rarely is a case diagnosed early enough for a cure.

## CHAPTER VIII.

### GENITAL ULCERS.

By B. C. CORBUS, M.D.

**Historical Review.**—The Bible is the most ancient as well as most reliable source from which early knowledge in regard to genital ulcers can be obtained.

The plague which fell upon the men who frequented the altars of Baal is supposed to relate to ulcerations of the penis, while the lamentations of King David over the sharp pains in his bones doubtless refers to the effects of venereal disease.

Changes in the throat and soft palate are mentioned by St. Paul in his epistle to the Romans. From all these it is fair to infer that genital ulcers with their accompanying effects existed in ancient days.

Hippocrates, among the early medical writers, speaks of ulcerations of the genital organs, of tumors of the groin, of ulcerations of the mouth, and of extensive pustular eruptions on the body.

Later, Celsus describes two varieties of ulcers on the penis, which he calls "*ulcera sicca*" and "*ulcera humida*." This division fits admirably well the description of today—the soft chancre, which suppurates freely, and the hard, which scarcely suppurates at all.

Celsus also describes the phagedena which may invade the ulcers at times.

Aretaeus describes the destruction of the uvula and soft palate.

Cribasius, like Celsus, divides the ulcers into dry and moist.

Galen speaks of ulcers of the scrotum, which he divides into two classes, deep and superficial.

Aretaeus and Paul of Aegina both make mention of ulcerations of different kinds that develop on the genital organs.

During the latter part of the fifteenth century (1496) syphilis was conveyed by sailors of Columbus to the inhabitants of Seville and Barcelona. From this date authentic transmission is well chronicled.

For want of a name the disease was called *morbus gallicus*, and on account of the primitive character of domestic relations at that time, hardly a family in Spain was free from it in 1494.

The cases became so numerous in Seville that special hospitals were opened to cope with the situation. During 1494 the whole of Italy was infected, progress being noted from town to town.

In 1495 France, Germany, and Switzerland became the seats of virulent outbreaks.

Holland and Greece in 1496.

England and Scotland in 1497.

Russia and Hungary in 1499.

In 1496 the Decree of the Parliament of Paris required all infected persons to leave the city.

In Scotland, during Cromwell's time in the seventeenth century.

In Norway in 1720.

In Prussia in 1757.

In Sweden in 1762.

In Holland in 1789.

In Uganda (Africa) in 1896.

At present syphilis exists everywhere in the world, being less frequent in the rural districts and most frequent in the large cities.

No historical sketch, however brief, should close without a reference to John Hunter and Philippe Ricord.

In 1767 John Hunter inoculated himself on the prepuce and glans with the pus from a virulent gonorrhea, and produced a chancre as well as constitutional syphilis. From this he concluded that the secretion from a case of gonorrhea was capable of producing all three diseases—gonorrhea, chancroid, and syphilis.

This unfortunate theory was not disproved until the masterful Ricord, by his careful and unbiased observations and researches, showed the different clinical entities of gonorrhea, syphilis and soft chancre.

**Classification.**—Genital ulcers are divided into two classes:

A. Venereal genital ulcers.

B. Non-venereal genital ulcers.

A. Venereal genital ulcers, which may be classified in the order of their importance, as follows:

1. Syphilis.

(a) Chancre.

(b) Ulcerated papule.

(c) Gumma or chancre redux.

(d) Esthiomène, or syphilitic hypertrophy of the vulva with ulcerations.

2. Erosive and gangrenous balanitis.

3. Chancroid.

## 1. SYPHILIS.

(a) **Chancre.**—**Synonyms.**—Primary sclerosis; initial lesion of syphilis; hard chancre; Hunterian chancre; *ulcus durum*.

**Definition.**—A true syphilitic chancre may be defined as the initial syphilitic lesion formed at the point of inoculation, and the first known collection of *Spirochæta pallida*.

**Etiology.**—**Predisposing Causes.**—(1) Alcohol; (2) venereal excesses; (3) promiscuous sexual indulgence.

**Exciting Causes.**—The *Spirochæta pallida* of Schaudinn and Hoffmann.

**Characteristic Features of the *Spirochæta pallida* as Observed with the Dark-field Condenser.**—The spirochetes when examined with the

dark-field condenser are much more typical than in the stained specimen, and are exact duplicates of tissue specimens stained by the Levaditi method. The most characteristic features are:

1. *Size*.—They vary in length from 7 to 21 microns, being from one to three times the diameter of a red blood cell. It is not uncommon to see the organism longer than this, but on account of the difference in the motions of the two extremities it is possible that these long forms are composed of two or more organisms.

2. *Shape*.—They are seen to consist of an extremely slender thread closely wound in a corkscrew or spiral spring form, the windings being very acute. In the fresh specimens the windings are absolutely regular, but as the specimen gets older the organism changes form, the most frequent change being an obliteration or irregularity of the windings in the central portion. This is a very common appearance in the stained preparations.



FIG. 135.—Microphotograph. *Treponema pallidum*. Dark-field view of an expressed specimen (serum) from a chancre.  $\times 1100$ . These are identical with the Levaditi-stained spirochetes as shown in Fig. 144.

3. *The Ends*.—These are sharp and terminate on the periphery of the spiral and not in the centre, as the *Spirochæta buccalis* and some of the other forms do. This peculiarity of the ends is only seen when the organism rotates on its long axis.

4. *Motility*.—When the specimen is freshly prepared the organism is very active and possesses the following motions: (a) A rotation on its long axis in either direction; this motion is very rapid, but not necessarily accompanied by change of position; as the specimen becomes older this motion grows less. (b) It progresses from place to place, but not so rapidly as the other forms of spirochetes commonly encountered. (c) They have a bending or twisting motion which is quite quick and spasmodic. This bending movement increases as the specimen ages and at times an organism is seen bent in the form of a circle, resembling somewhat a crenated red blood corpuscle. It is not uncommon to find two organisms joined end to end.

**Histology and Pathology.**—The abundant discharge from a fresh, specific primary lesion, if untreated, contains a large number of *Spirochæta pallida*, but if seen before the lesion has broken down, their demonstration may be difficult, unless gentle scarification and cupping are practised.

The spirochetes are irregularly distributed in the foci, which accounts for failure at times to demonstrate the organism after the Levaditi method. This more or less irregular distribution of the spirochetes occurs more particularly in fresh lesions. As the spirochetes are responsible for the periarteritis and endarteritis, they are found most abundantly in tissues immediately surrounding the bloodvessels, in the walls of the vessels themselves, in the lymph spaces, and in the Malpighian bodies (Figs. 136 and 137).



FIG. 136.—Chancre of penis (low power). Shows moderately advanced lesion, blood-vessels much increased, with walls thickened. Marked proliferation of endothelial leukocytes into walls of vessels, causing endarteritis. In the connective-tissue stroma exudate is marked, consisting of polymorphonuclear leukocytes and plasma cells. (Author's case.)

The initial sclerosis shows in the early stages a lymphocyte and plasma-cell infiltration around the blood and lymph vessels in the depth of the cutis and the papillary bodies. Gradually the lumen of the bloodvessels becomes widely distended, there is swelling and proliferation of the endothelium and formation of new capillaries. Inflammatory changes and proliferation occur in the tissues surrounding the vessels. This congestion and proliferation of the capillaries increases, the vessels become thrombosed, resulting in destruction of the vessels and a degeneration of the cellular exudate. Gradually

the epithelium covering the lesion shrinks and becomes necrotic, while the papillæ in the vicinity of the erosion become enlarged and the infiltration extends out over the ulcer onto the surrounding epithelium, both laterally and deeply; later more extensive inflammatory changes result in and about the arteries, veins, and lymph vessels. There is an increase of yellow elastic fibers.

It is this condition which constitutes the specific induration, and the amount of induration will depend on the depth of the vessels which are affected.

**Incubation.**—The period of incubation is from ten to twenty-eight days (exceptional cases longer); most frequently from fourteen to twenty-one days.

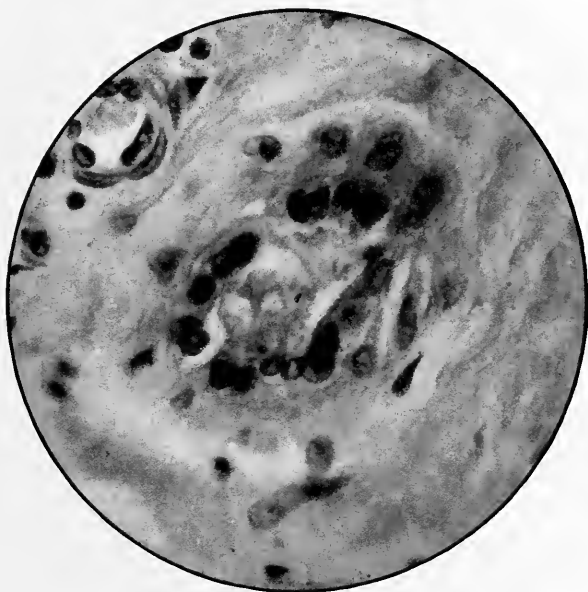


FIG. 137.—Chancre of penis (high power). Shows wall of bloodvessel infiltrated with many endothelial leukocytes.

**Classification:** A. Anatomical. B. Clinical.

A. ANATOMICAL CLASSIFICATION.—The location of the primary lesion depends on the site of contact and inoculation and may be anywhere on the genitals, *i. e.*, scrotum, labium, urethra, glans penis, etc.

B. CLINICAL CLASSIFICATION.

1. Chancrous erosions.
2. Chancrous ulceration, superficial and deep.
3. Indurated papule.

A chancre is not auto-inoculable after ten days, but may be so before. It is, as a rule, single (single point of contact) but may be double or multiple (multiple point of contact). The author has had the opportunity of observing a case in which there were five lesions arranged

around the glans penis, somewhat resembling a collar, in each of which *Spirochaeta pallida* were demonstrated.

1. *Chancrous Erosions*.—After variable periods of incubation, depending on the virulency of the spirochete and the receptiveness of the host, the chancre manifests itself. At first there is a hyperemic area; this later becomes a superficial papule and still later, through its inherent pathology, slight traumatism and mild secondary infection becomes a superficial erosion, thus marking the beginning of the chancre. A common form seen is a "small abrasion," and on account of its insignificant appearance is most frequently permitted to go undiagnosed for some time.

Induration, as a rule, is very slight or entirely absent. Later this erosion enlarges and assumes a more deeply red appearance and may pass into the following:

2. *Chancrous Ulceration, Superficial and Deep*.—The superficial erosion rapidly extends in breadth and depth. Induration is the rule and may be marked, but is always superficial at first. The ulcers are dusky red, circular and slightly cup-shaped, with smooth, slanting walls. A false membrane may be adherent over the lesion, and slight irritation causes an abundant exudation of serum. Later the induration extends deeper, the ulcer destroying the true skin as well as the tissue beneath it.

3. *Indurated Papule*.—In this form the lesion occurs where the integument is thick; it retains its papular form and may attain large dimensions, 0.5 to 2.5 cm. in diameter; its surface remains intact, and, as a rule, there is little excretion.

Morton<sup>9</sup> says: "The forms of the chancres differ, depending on the anatomical part on which they are located and also on the course and situation of the bloodvessels.

"When they run horizontally and near to the surface, a thin, flat layer of infiltration occurs under the skin, which is called *parchment induration*. On the other hand, when the bloodvessels dip down deeply into the tissues, the induration is extensive and deep and is called *Hunterian induration*" (Figs. 138 and 139).

For example, inside the prepuce the parchment chancre often occurs; in the sulcus coronarius, a heavy mass of infiltration takes place, forming a Hunterian chancre. In the frenulum a thick cord occurs, and on the glans a flat erosion.

*Pain*.—All primary lesions are characterized by their lack of discomfort, both local and constitutional, unless complicated by a mixed infection or situated where there is continually a change of its base (urethral chancre). Inflammation, except over the site, is usually slight, the patient's attention being first drawn to the condition by stinging and burning, as if he had been bitten by a fly or some small insect.

In careless individuals and those who are slovenly in their toilet, a chancre may attain large proportions before it is noticed.

In most chancres an abundant exudation of serum can easily be pro-



FIG. 138.—Typical Hunterian chancre. (Author's case.)



FIG. 139.—Same as Fig. 138, twelve days after injection of 0.5 gm. salvarsan. (Author's case.)

voked by gentle irritation or cupping, this being due to the abundant vascular supply.

**Diagnosis.**—So rapid and exact have become our methods of diagnosis in primary lesions that the physician who fails to avail himself of these accurate and specific diagnostic methods should be held responsible.

Many physicians, seeing a lesion for the first time, thoughtlessly prescribe a little dusting powder, while all the time the organisms of syphilis are multiplying, and daily the possibility of a speedy cure lessens.

A favorite dusting powder for genital ulcers is calomel. This dusted on a lesion temporarily destroys the spirochetes *in situ* and it may be several days before all the powder can be removed; in the meantime the disease slowly progresses. Occasionally puncture of the inguinal glands will reveal the organism, but this is not an easy procedure.

The safest method for the patient and his physician is to treat all ulcers in the light of a specific origin—apply no treatment whatever and permit no mutilation in the way of cauterization until it has been thoroughly demonstrated by a careful laboratory worker that syphilis does or does not exist. The removal of sufficient clothing to permit a thorough examination of the body should be insisted on. Often the clinical picture at the secondary period is so pronounced that added laboratory findings are only confirmatory; however, in the primary stage, without laboratory confirmation, one should not feel safe in making a positive diagnosis.

*The Dark-ground Illuminator.*—This method was described by the Rev. J. B. Read in 1837. He used practically the same apparatus that we are using today. Read described his method just at the time that Professor Abbe brought out his well-known substage condenser, and in the excitement over Professor Abbe's invention, the dark-ground illuminator was forgotten until rediscovered by Reichert, the microscope manufacturer of Vienna, in 1907.

The advantage of this method depends on the illumination, the principle of which is the same as that causing dust particles to become visible when passing through a beam of sunlight.

The apparatus of Reichert consists of a metallic plate, having a hole in the centre, above which is fitted a piece of glass having a circular excavation on its under surface. The sides of this excavation are ground at a certain angle and silvered. By means of a revolving disk, different-sized diaphragms are used to cover the central part of the excavated area, so that when the light is reflected up from the plane mirror of the microscope, only the marginal rays reach the glass plate. These impinge on, and are reflected by, the silvered sides of the excavation to a central point 1 mm. above the surface of the glass plate. Any solid body here will intercept these rays and appear as luminous objects on a dark ground. By this method it is possible to see the particles of colloidal substances in their solutions (Figs. 140 and 141).

*The Reichert Instrument.*—A form of dark-ground illuminator is now manufactured by most of the microscope makers, but the Reichert instrument is superior to others for the following reasons:

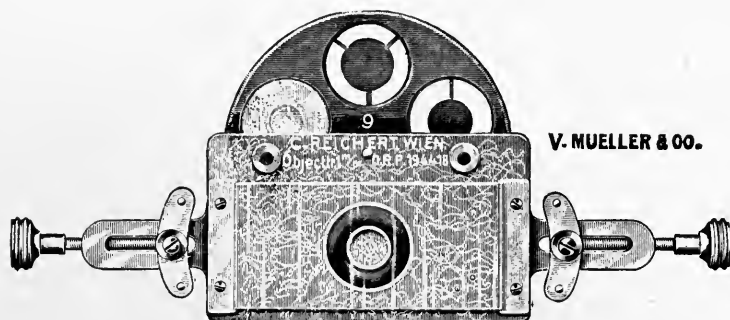


FIG. 140.—The Reichert apparatus for "dark-ground" illumination, to be attached to the microscope stage.

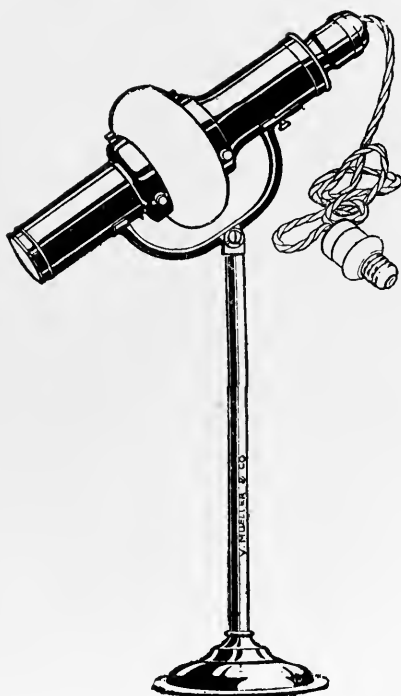


FIG. 141.—Nernst lamp. For use with the Reichert dark-ground illuminator.

1. It can be used on any kind of microscope.
2. The light may be varied at will, by means of the revolving diaphragm.
3. It is possible to change from the dark-ground method to the

ordinary method of transmitted light merely by revolving the diaphragm.

The method of using the apparatus is as follows:

The Abbe condenser is removed. A strong light is necessary; one may use the sun, an arc light, a Nernst lamp, or an inverted Welsbach. With the inverted Welsbach, a six-inch condenser lens is necessary, or a large glass globe filled with water serves the same purpose. The illuminator is placed on the stage of the microscope, and by means of the low power the circle which is etched on the glass plate is brought into the centre of the field and the apparatus fixed in this position by means of the clips of the microscope. A drop of immersion oil, free from air bubbles, is placed on the centre and the prepared slide put in place, great care being taken to avoid the formation of air bubbles. When the preparation is examined with the low power, if the light is placed right and the apparatus centred, a bright central point will be observed. The high power is now turned on and the field is seen to be dark, with luminous points and bodies.

*Preparation of the Materials.*—The method of preparing the specimen is very important. The slide must be 1 mm. thick, and both slide and cover-glass must be perfectly clean and well polished, as any turbidity or scratches disperse the light and cause annoying halos, which prevent the dark-ground effect and interfere with the examination. Air bubbles in the specimen also cause these disturbing effects. The specimen must be as thin as possible. The observation is best made with a dry system. The author uses a Leitz  $\frac{1}{8}$ -inch objective and a No. 5 ocular. An oil immersion can be used; in this case, however, it is necessary to diminish the aperture of the objective by inserting a truncated cone back of the front lens of the objective. This cuts out the diverging rays of light, which otherwise would flood the field. For diagnostic purposes it is seldom necessary to use the oil immersion.

*Method of Obtaining the Material.*—For chancre (Fig. 142) it is sufficient to clean the lesions thoroughly with warm water. They are then irritated by being rubbed vigorously with a piece of cotton wrapped on a probe, thus causing an abundant exudation of serum. This is collected by means of a capillary pipette as shown in Fig. 142. A small drop of this is placed on a cover glass, which is now carefully inverted on the slide as in making a fresh blood preparation. It is well not to have much admixture of blood, as the blood cells interfere somewhat with the observation.

On looking at a specimen containing serum from a chancre, numerous small, round, luminous bodies are seen, which have a very active Brownian movement. These particles of albumin are probably identical with the blood dust of Müller. If the cleansing has not been thorough, various forms of bacteria are often seen, the cocci looking like pearls. The leukocytes are seen as a mass of white granules surrounding the dark nucleus, the various forms being easily differentiated. The ameboid movement and the granules in an active

Brownian motion are frequently seen. The red corpuscles show as a luminous ring surrounding a central pale reddish zone.

*Staining Methods.*—Schaudinn and Hoffmann's many attempts at staining the *Spirochæta pallida* did not prove successful, until finally



FIG. 142.—Method of collecting serum from suspected lesion by capillary attraction.

they succeeded with Giemsa's solution. It would be out of place in such a work as this to give a detailed account of all the methods which have been developed for this purpose, and mention will be made only of those of most practical value.

*Giemsa's Ordinary Method.*—(Fig. 143):

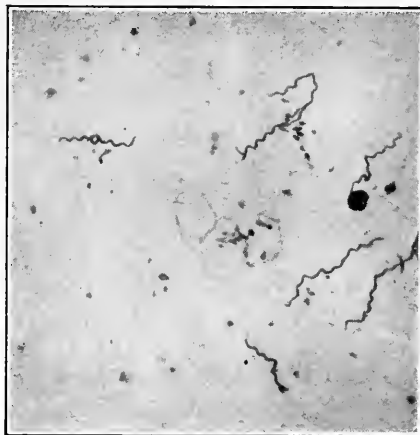


FIG. 143.—Microphotograph of *Treponema pallidum* from chancre. Giemsa stain.  $\times 1100$ . (Author's case.)

1. Fix the film for five minutes in absolute alcohol.
2. Dilute the stain in tap-water or distilled water to which a drop or two of a 1 to 20,000 solution of sodium carbonate has been added; use about 30 drops of the stain to every 20 c.c. of water.

3. Pour the stain into a shallow dish and place the preparation face downward in it. The slide is prevented from touching the bottom of the dish by two pieces of glass tubing.

4. Staining is complete in from one to twelve hours.

5. Wash gently in water, and dry.

*Giemsa's Rapid Method:*

1. Fix as above.

2. Dilute the stain with an equal volume of water containing 1 to 20,000 solution of sodium carbonate.

3. Pour the stain onto the film, and heat the slide gently over a Bunsen burner until vapor is given off. Replace the stain with a fresh quantity and heat again. This process should be repeated three or four times, the final application lasting two minutes.

4. Wash in water, and dry.



FIG. 144.—Microphotograph. Spirochetes from the liver of a congenitally luetic infant, stained after Levaditi's method.  $\times 1200$ . (Author's case.)

*Levaditi's Method* (Fig. 144).—This method is really a modification of that used by Ramon y Cajal for demonstrating nerve fibrils, and owing to its freedom from precipitates in comparison with the other silver stains, is now almost universally employed to demonstrate spirochetes in the tissues.

The method is as follows:

1. Fix fragments of the tissue, not thicker than 1 or 2 mm., in a 10 per cent. solution of formalin for twenty-four hours.

2. Wash in water and transfer to alcohol (96 per cent.) for twenty-four hours.

- 3. Wash in distilled water until the pieces of tissue fall to the bottom of the jar.
- 4. Impregnate from three to five days at 38° C. in a 2 per cent. solution of silver nitrate in the dark.
- 5. Wash in water and reduce overnight at the temperature of the room in the following bath:

Acid pyrogallie . . . . .	4 gm.
Formalin . . . . .	5 c.c.
Water, distilled . . . . .	91 c.c.

- 6. Wash in water, dehydrate, and embed in paraffin in the usual way.
  - 7. Cut the sections not thicker than 5 microns and mount in Canada balsam. No further staining is required, though Levaditi has recommended counter-staining with toluidin blue, neutral red or Giemsa's solution.
- Levaditi and Mamouelian's Rapid Silver Method.*—Levaditi recommends this method for staining tissues which have been removed during life, or immediately after death.

- 1. The tissue is cut and fixed as in the previous method.
- 2. Impregnate in the following solution for twelve hours at room temperature, and then for five or six hours at 55° C.:

Silver nitrate solution, 1 per cent. . . . .	90 c.c.
Pyridine . . . . .	10 c.c.

- 3. Wash in water and reduce in the following solution overnight:

Pyridine . . . . .	17 c.c.
Acetone . . . . .	10 c.c.
Acid pyrogallic (4 per cent.) . . . . .	90 c.c.

- 4. Dehydrate, and embed in paraffin in the usual way.
- 5. Cut sections not thicker than 5 microns.

The India-ink method of Burri, while recommended as short and reliable, is a poor makeshift. The demonstration of the spirochetes is complicated by too many artefacts (Fig. 145).

Although a wonderful advancement has been made in the treatment of syphilis, comparatively few realize the role that the early diagnosis plays in the cure of the patient.

Many staining methods for the detection of the spirochete have been recommended as short and reliable, but none has as many advantages as the dark-field condenser, as here the demonstration of the living spirochete is characteristic and distinct. From an experience dating from the year 1908, consisting of many hundreds of examinations, the author considers that the one and only method for use is the dark-field condenser. The advantages of this method depend on the illumination, which is greatly facilitated by the new Nernst lamp. This style of lamp has an advantage over the arc light, in that it gives

a continuous, strong light, with no breaking or closing of the circuit or burning out of carbons.

Noguchi's method of snipping out a small piece of the lesion and macerating it with salt solution in a mortar offers an excellent way of obtaining the organism in large quantities, for in this manner they are expressed from the lesion and appear abundantly.

The universal procedure of making a smear from a lesion, just as one would do in making an ordinary pus smear, should be emphatically condemned, as it is absolutely impossible for the laboratory in this way to do itself justice.

*The Wassermann Reaction.*—Frequently the Wassermann reaction is resorted to as a final word in diagnosis. It must be distinctly understood that the Wassermann test cannot be relied on at the period of primary invasion; that the reaction is positive in direct proportion to the time of the presence of the primary lesion; that the reaction is nearly always negative until about three weeks after the first appearance of the sore, and after that period it is invariably positive.

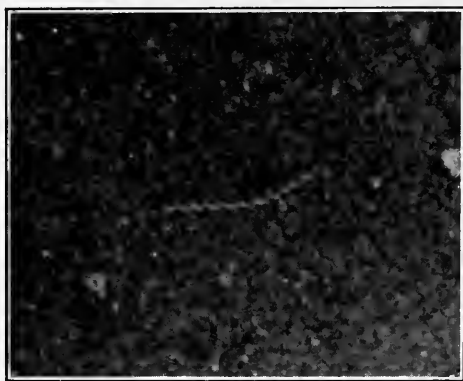


FIG. 145.—Microphotograph of *Treponema pallidum* from chancre. Burri's India-ink method.  $\times 1600$ . (Author's case.)

However, during the presence of the primary lesion there are two things that we wish to know. They are:

- (1) The result of the Wassermann reaction on the blood, as a biological guide to future treatment; and if this should prove positive,
- (2) the result of the spinal fluid examination as a control on future complications of the nervous system.

1. *Wassermann Reaction on the Blood.*—For example, a patient presents himself for examination. Diagnosis is made by finding the spirochete in the primary lesion. Assume that the Wassermann examination is negative. This shows that the system is not involved to any great extent and the possibilities of a speedy cure are good. On the other hand, take a similar case in which the diagnosis is made by finding the spirochetes in the primary lesion, but with the Wassermann examination positive. This shows a considerable systemic invasion and is not so favorable for a speedy cure.

It is not generally recognized that the consumption of even small quantities of alcohol, if taken from one to seven days before the Wassermann is made, tend to influence the test by producing a false negative reaction. Attention was first called to this by Craig and Nichols,<sup>2</sup> of the United States Army, and since then it has been verified by serologists generally.

2. *Spinal Fluid Examination*.—During the past two years, numerous observers, both in this country and abroad, have called attention to the fact that the nervous system is already involved in early syphilis, a thing almost undreamed of before this time. This involvement seems to be due to a selective type of spirochete, and it becomes our duty to puncture the spinal canal in those cases which show a strong positive Wassermann, if we wish to control the situation here as well as in the blood stream.

The spinal fluid examination consists of the following:

1. Wassermann reaction.
2. Cell count.
3. Globulin reaction.
  - (a) Noguchi.
  - (b) Nonne-Apelt.
4. Pressure.

*Technic*.—Lumbar puncture is always performed best with the patient lying on his side. Inasmuch as 5 c.c. of fluid are essential for a proper examination, it is advisable to perform the puncture only in a hospital. During the withdrawal of the fluid, the patient should lie absolutely flat (without pillow) and this position should be maintained for twenty-four hours, with the addition of the elevation of the foot of the bed after the patient has been removed from the operating room.

1. *The Wassermann Reaction*.—Of all the tests, the Wassermann reaction on the spinal fluid is the most reliable. Frequently, however, an error has been made in taking too small a quantity of this fluid; at least seven times the quantity that is required for the blood Wassermann is absolutely essential for accurate results.

2. *Cell Count*.—The following standard of Dreyfus,<sup>4</sup> based on 750 punctures, is recommended by Ellis and Swift,<sup>6</sup> of the Rockefeller Hospital:

- 1 to 5 cells per c.mm.—Normal.
- 6 to 9 cells per c.mm.—Doubtful, border cases.
- 10 to 20 cells per c.mm.—Slight lymphocytosis.
- 21 to 50 cells per c.mm.—Moderate.
- Over 50 cells per c.mm.—Marked.

*Technic of Leukocyte Count of Spinal Fluid*.—The apparatus employed is the Turk. The spinal fluid to be tested is thoroughly shaken. Draw up in the white-cell counting pipette 10 per cent. acetic acid to the mark I, then the spinal fluid to the mark II. This gives an employment of 9 parts of spinal fluid to 10 parts of the mixture, or  $\frac{9}{10}$  of the mixture is spinal fluid. Blow out the first few drops of the

solution from the pipette and then place on the chamber just sufficient fluid so that with pressure of the cover-glass Newton's rings appear at the four corners. Count the cells in the whole ruled area. This space contains  $\frac{9}{10}$  c.mm. of fluid. The mixture is  $\frac{9}{10}$  spinal fluid and  $\frac{1}{10}$  diluting fluid. Therefore the number of cells counted  $\times \frac{10}{9} \times \frac{10}{9} =$  the number of cells per c.mm. For example, the 9 sq. mm. contains 40 cells.  $40 \times \frac{10}{9} \times \frac{10}{9} = 49$ . If cells are so numerous as to cause clouding, the spinal fluid must be diluted as for a leukocyte count of the blood.

3. *Globulin*.—This test may be made after the method of Noguchi or the method of Nonne-Apelt.

*Technic of the Noguchi Butyric Acid Test*.—To 0.2 c.c. of spinal fluid add 0.5 c.c. of 10 per cent. butyric acid in physiological salt solution. Boil carefully over a small flame for one minute and add quickly 0.1 c.c. of normal sodium hydrate and boil again for a few seconds. In the presence of excess globulin, a precipitate forms of varying intensity, depending on the amount of globulin present. A cloud may appear in normal fluid.

*Technic of the Ross-Jones Modification of the Nonne Test*.—Float on top of about 0.5 or 1 c.c. of supersaturated (by heat) ammonium sulphate solution, about one-half the quantity of spinal fluid. In the presence of excess globulin a white ring forms. In case of small quantity of globulin, if the ring is either absent or indistinct, shaking the tube will cause the clouding to become prominent.

4. *Pressure*.—Pressure is estimated by allowing the fluid to run into a graduated manometer tube with a bore 3 mm. in diameter and reading the height to which the fluid rises. This figure is only relative.

**Necessity for Spinal Fluid Examination in Syphilis**.—Ever since the discovery of Noguchi<sup>11</sup> that the cerebrospinal fluid in paresis, cerebrospinal syphilis and tabes contains live active spirochetes which are capable of being transmitted to animals, a new light has been thrown upon subarachnoid involvement. How this involvement takes place is not exactly known; whether the spirochetes are capable of passing through the choroid plexus, or advancing along the lymphatics that accompany the nerves, future investigation will have to determine.

There is little doubt, as Mott<sup>10</sup> has already shown, that there is a selective type of organism that has a predilection for the nervous system.

**Differential Diagnosis**.—Notwithstanding the many newer diagnostic methods that are in vogue, clinical symptoms should be carefully noted and the laboratory carefully checked up, especially since there are so many laboratories whose reports are conflicting.

*Scabies*.—Occasionally there occurs on the glans penis an isolated area of scabies. If the surgeon will take the trouble to have the patient remove his clothing, as a rule, numerous evidences of this parasitic affection can be found on other parts of the body. There is no period of incubation and microscopic examination for spirochetes is negative. The condition remains as a papule with no inguinal

adenopathy; itching is a prominent symptom, especially after retiring at night.

(See end of chapter for tabulated points of diagnosis of Chancre, Chancroid, Herpes Zoster and Erosive and Gangrenous Balanitis.)

**Prognosis.**—The prognosis in all uncomplicated luetic lesions is excellent, but to say that every case with its attending systemic infection can be cured is just as foolish as to say that no case can be cured. The curability of syphilis depends on making a prompt diagnosis, for the earlier a case comes under observation, the easier it is to effect a cure. That the biological method offers the best means of controlling the treatment of the disease there can be no question. Unfortunately, the tendency is to give too little treatment.

**Prophylaxis.**—The use of a condom during sexual relations is perhaps the best safeguard against infection. Metchnikoff's calomel ointment (calomel 20, lanolin 40), if used up to within two hours after exposure, has proved a reliable preventative in the army and navy. As reliable substitutes, mercurettes (Parke, Davis & Co.) and 50 per cent. mercury ointment may be used. Recently, Schereschewsky<sup>13</sup> has proved experimentally upon apes that 40 per cent. quinine is safe and efficient, if applied after the same method as the mercury ointment.

As the primary lesion is only a local manifestation of a general infection, the treatment may be divided into local and systemic.

**Local Treatment.**—No treatment, either general or local, should be instituted before a positive diagnosis is made.

**Excision of the Chancre.**—As the initial lesion of syphilis is the first-known collection of spirochetes, Lukasiewicz, Jadassohn,<sup>7</sup> and others declare that if excision of the chancre is done before the period of second incubation, the infection is attenuated. It is reasonable to suppose that if we have a large area that is constantly feeding the system with infecting organisms, that area should be removed, especially since its removal does not entail any serious effects on the patient. Whenever it is at all possible, without undue loss of tissue, the chancre should be excised. In those cases in which the lesion is so situated that its removal would cause extensive destruction of tissue, one should be satisfied with thorough cauterization and curettement and the free use of calomel. In cases in which either excision or curettement would cause a troublesome scar (urethral chancre), calomel dusting powder should be used.

**General Treatment.**—As soon as the diagnosis of a specific infection is established, systemic medication should be resorted to (within the next five minutes, if possible). No time should be lost, as every minute is valuable. Either salvarsan or mercury should be given at once. The plan that the author has adopted is to give 10 m. of 1 per cent. cyanide of mercury solution at once, and as soon as possible, preferably within the next two hours, a full dose of salvarsan or neosalvarsan intravenously.

**Status of Salvarsan after Five Years.**—Notwithstanding that deaths have occurred both in this country and abroad following the use of

salvarsan, and notwithstanding differences of opinion regarding its value and toxicity, the author believes it still remains the most powerful spirilloicide that we possess. If used with discretion and judgment, it is the most valuable single weapon we have in combating the infection, and as for the contra-indications, in small doses, not to exceed 0.3 gm. once in seven to ten days, the author believes there are none. That the substance is neither harmful to the nervous system or kidneys has been proved by Doinikow<sup>3</sup> and Wechsellmann.<sup>15</sup>

Unquestionably the fatalities and complications laid at the door of salvarsan are errors in technic. Briefly and in order of their frequency these errors are:

1. Use of water that contains saprophytic bacteria.
2. Oxidation of the drug.
3. The question of whether the solution is hypotonic or hypertonic.

Considering the wide use of salvarsan, it is safe to say that 95 out of 100 doses are given with water that is neither freshly distilled, filtered, or sterilized, and, as a consequence, toxic effects are common. Few users of salvarsan or neosalvarsan realize that the drugs are very unstable and that oxidation occurs rapidly; in the latter, according to Ehrlich,<sup>5</sup> 300 per cent. in a half-hour. In 1916 supplies of salvarsan and neosalvarsan coming from the manufacturers in Europe seemed to be extremely toxic. How this is accounted for the author cannot say.

Probably few observers understand that distilled water is capable of dissolving red corpuscles, and with an easy water-soluble salvarsan (as neosalvarsan is) solutions are often made which are capable of doing this in the blood stream after they are injected. This is particularly pointed out by Ravaut.<sup>12</sup>

For the sake of "safety first," it is demanded that all solutions be made with freshly distilled (not over five hours old) water, properly filtered and sterilized. The solution should not be permitted to stand over five minutes before using and should always be hypertonic.

*Number of Injections.*—Primary lesions which come under observation before the Wassermann is positive: Salvarsan, 0.6 gm., or neosalvarsan, 0.9 gm., should be given once every week for four weeks; then one month's vigorous rubbings with mercuric ointment, followed by two more intravenous injections of salvarsan with two weeks' interval. Primary lesions which come under observation after the Wassermann is positive should have salvarsan or neosalvarsan every week for four weeks, to be followed alternately by mercury rubbings and salvarsan or neosalvarsan for four months, giving the salvarsan or neosalvarsan every month.

*Intravenous Technic for Salvarsan.*—The instruments are one large 250 c.c. cylinder (Fig. 146, *B*), filter papers, one funnel, one intravenous apparatus, like that shown in Fig. 147, one graduated pipette (Fig. 146, *A*), and one stock bottle of normal sodium hydroxid solution (4 per cent.)

The instruments and filter paper having been previously sterilized (which may be accomplished for the latter by moist heat and later

drying between sterile towels, and for the ampoule of salvarsan and a file by immersion in alcohol), the ampoule is opened with the sterile file and the contents poured into the cylinder. As this salt goes into solution very much more readily than the earlier supplies of the substance, it is not necessary to add any glass pearls to assist in the mixing. Fifteen cubic centimeters of hot water are added, and the salt put into solution. Next the normal sodium hydroxide solution is added (about 2 c.c.), and shaken thoroughly. A precipitate occurs. Then sodium

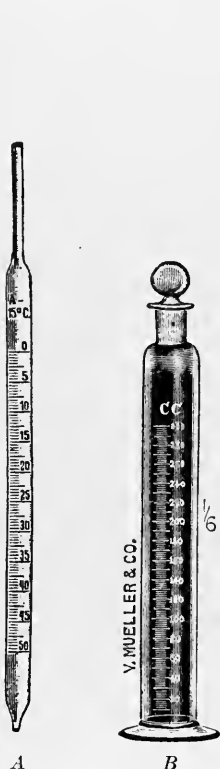


FIG. 146.—Graduated pipette (A).  
Large 250 c.c. cylinder (B).

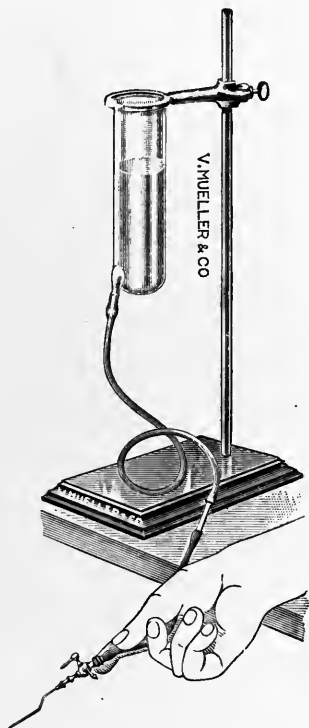


FIG. 147.—Corbus's intravenous apparatus.

hydroxide solution is added, drop by drop, the solution being shaken after each drop until it is absolutely clear, care being taken not to add an excess. Next distilled water is added up to 260 c.c. The whole is then filtered into the receptacle which accompanies the intravenous apparatus. Here the outlet is in the side of the cylinder, slightly above the bottom, forming a little receptacle that holds any foreign material that may get into the cylinder, thus ensuring the injection of a more perfect solution. It is not necessary to use normal saline solution, as the above solution is very nearly isotonic.

The arm is thoroughly scrubbed and a constrictor placed above the

elbow. After taking care that the solution runs through the tube and needle easily, and that it is not above 98.6 F., and that air bubbles are absent, the needle is thrust into the vein, great care being used not to puncture the vein except to enter its lumen, for any of the solution elsewhere than in the vein will produce a marked paraphlebitis. With the two-way cock attachment, it is easy to tell when one is in the lumen of the vessel, as the blood will come pouring out. Then remove the constriction, turn the cock and send the solution into the vein. With the cylinder raised 28 to 30 inches above the patient's head, and with an 18-to 20-gauge needle, the solution will enter the vein in from seven to twelve minutes.

It is true that filtering the solution may seem to be superfluous, but often the salt agglutinates and there are small gelatinous particles that do not dissolve; and again, sometimes, there may be some splintering of glass in opening the ampoule. Therefore, in order to carry out this technic in the best possible manner, it is better to filter the solution so that it will be perfect.

When the solution has passed into the vein and the injection is at an end, the two-way cock is turned so that the blood returns through the side outlet. In this way it is possible to wash the puncture area with the patient's own blood, thus avoiding the use of salt solution.

Neosalvarsan may be given with the same apparatus in concentrated solution, or by means of a 20 c.c. syringe.

The author's experience with many hundreds of cases, dating since the year 1910, has been devoid of accidents or deaths and the above technic for salvarsan administration has been used exclusively.

*Intramuscular Technic for Salvarsan.*—All intramuscular injections of either salvarsan or neosalvarsan should only be mentioned to be condemned. It is true that the method prolongs the elimination of the drug, but it is attended by severe pain and induration, often followed by abscess and necrosis.

The time of the presence of the primary lesion is ideal for intravenous medication, as it catches the spirochetes during their passage through the tissues.

(b) **Ulcerated Papule.**—Occasionally during the period of secondary invasion numerous ulcerated papules are seen on the genitalia. This is more frequent in the areas in which there is less moisture in contradistinction to the condylomata, which occur on moist surfaces.

The diagnosis should not be difficult, as secondary lesions are, as a rule, found on other parts of the body. The *Spirochæta pallida* are easily demonstrated by means of the dark-field condenser and the Wassermann is always positive.

(c) **Gumma. Chancre Redux.**—Quite frequently are seen the so-called chancre redux, which is nothing more than a recurrence at the site of the previous primary sore. They may appear any time from a few weeks after the healing of the primary sore to ten to twelve years afterward. Occurring after several years, they are regarded as gummata by most observers.

Without any exact time of exposure or apparent period of incubation, a small localized papule makes its appearance and rapidly breaks down and ulcerates, forming a typical solitary cutaneous gumma. The diagnosis should not be difficult with a previous history of lues.

There is no question but that this form of lesion has been frequently reported as a "second case of lues in the same individual," but this was before the discovery of the *Spirochaeta pallida* and the Wassermann reaction. It is possible always to find the spirochetes in a primary lesion and never possible to find them in a chancre redux with the dark-field condenser or any staining method. As the spirochetes are found deep in the tissues, however, their demonstration after the tissue method of Levaditi is possible. Treatment should be vigorous and systematic.

(d) **Esthiomène or Syphilitic Hypertrophy of the Vulva with Ulcerations.**—The term esthiomène, established in medical literature by Huguier in 1849, has been misunderstood and misapplied by many authors.

In June, 1913, Dr. Lena Kurz<sup>8</sup> reviewed the literature to date and demonstrated clearly that this clinical entity is a manifestation of tertiary syphilis. She says in part as follows:

"A careful analysis of the cases of esthiomène that we were able to study, and the vast amount of literature published on the subject, led us to the conclusion that it is a manifestation of tertiary syphilis and that the syphilitic virus is the sole cause of the condition. There can be no doubt that a number of accessory factors have a marked influence on the course and appearance of the esthiomène, but they could not be mistaken for the causes of a state which, considered from every possible point of view, bears the stamp of syphilis. Such accessory causes are inflammation, abscesses, uncleanliness, and above all, a low state of health aptly termed by the French 'la misère physiologique.' That irritation with inflammation of the parts can be the sole causative agent of a state characterized by deep and wide-spreading ulceration extending into the pelvic organs, is inconceivable. Nor can we understand how recent authors can read 'tuberculosis' into a case of esthiomène, which is so different in appearance, histology, symptoms and results from a tuberculous state of the vulva. A case of esthiomène is occasionally encountered, which may, at the outset, simulate tuberculosis, cancer or indurative elephantiasis edema. Such cases are, however, rare, and a careful inquiry into the history of the case cannot fail to enlighten the student regarding the class of disease to which such a case should be relegated. When a portion of tissue can be removed for examination, a first glance through the microscope reveals its true nature. A positive Wassermann reaction will confirm it. With our present-day knowledge of the bacillus of Koch, the *Spirochaeta pallida*, the tissues of gummata, cancer, etc., and with the serum test for syphilis, no mistake regarding the diagnosis of esthiomène can arise. In recent years the term lupus vulva has characteristically given place to 'tuberculosis of the vulva,' and the name *ulcus vulvæ* has

been dropped. Huguier's term 'esthiomène' is now but rarely used, which seems a matter for regret, for if used in the definitely understood sense that it is a tertiary syphilitic manifestation, it replaces the cumbersome expression 'syphilitic hypertrophy of the vulva with ulcerations.'"

The disease occurs among the poor and neglected. Servants, laundry workers, wives of soldiers and sailors, are among the most frequent sufferers. Sterility, relative and absolute, is common. The disease is most common between the ages of twenty and forty, yet it may appear before or long after that age.

A granuloma appearing in the region of the perineum after a long period of apparently perfect health is a common manifestation of "latent syphilis."

**Symptoms.**—Esthiomène may persist for many years without producing any marked change in health; however, it is most frequently accompanied by anemia, lassitude, headache, and rashes.

It is surprising how little inconvenience esthiomène may cause the sufferer. Some apply for medical relief early because they are alarmed by the presence of the ulcers and the thickening of the parts; others do not come for advice until itching or discharge cause inconvenience. At present it is uncommon for patients to wait for relief until the ulceration has attacked the urethra, bladder or rectum. There is rarely any pain, and examination of the parts causes no suffering. The painlessness of syphilitic ulcers is a characteristic feature.

**Enlarged Inguinal Glands.**—The presence or absence of enlarged inguinal glands does not influence the diagnosis of esthiomène. Where enlarged glands are reported, it is frequently the case that esthiomène has supervened on the secondary stage of syphilis. With extensive ulceration of the vulva it is natural to find "septically infiltrated" glands. Such glands are usually large, firm, elastic and isolated, easily distinguished from the hard, small, shotty buboes connected with each other by thick, stringy lymph channels, so typical of early syphilis. Both types of glandular enlargements may be present in esthiomène. Often no infiltration is palpable, even in a severe case.

**Cicatricial Tissue in Tertiary Syphilis.**—The cicatricial tissue which follows in the wake of syphilitic ulceration is characterized by its bulk, its tendency to contract strongly and to break down again into ulceration. These features we find present in the fibrous tissue following esthiomène. The deformity found may be enormous, the parts being anatomically unrecognizable; strictures follow even slight degrees of esthiomène; repeated breaking down of healed ulcerations and of hypertrophied masses are characteristic of the chronic condition.

**Duration, Course, and Causes of Death.**—The chronicity of esthiomène is a significant feature. All syphilitic ulcers are notoriously slow to progress and slow to heal. In no other ulcerative condition is the history so prolonged, so eventful of recurrences, and so little disturbing in its effects. The course depends largely on the early recognition and treatment of the condition. It may last a few months only, result-

ing in cure, or a great many years, with death of the patient. Phagedena is a rare complication.

**Pathology.**—The hypertrophied masses of esthiomène are gummatous and consequently undergo the same fate as gummata elsewhere. They necrose, leaving indolent, chronic, slow-spreading ulceration. The cell elements are the same as those of gummata; the inflammatory cells are mostly plasma cells and lymphocytes. Numerous capillaries are present; the fibrous coats of vessels are also thickened, even at an early stage. Later the intima of the vessels is also thickened. At any period of the existence of the gumma it may break down. This



FIG. 148.—Syphilitic hypertrophy of the vulva, with ulcerations (low power). Shows very dense fibrous tissue of old standing with many wavy strands of connective-tissue fibers and few cell elements. The bloodvessels are exceedingly sclerosed; the connective-tissue laminae in the vicinity show a concentric arrangement around the vessels. Extensive fatty degeneration of the tissues is taking place. (From Lena Kurz's article.)

breaking down may occur early when the surrounding tissues of the necrosed area are still infiltrated with plasma cells and the granulation tissue is new and vascular. Or it may occur later when the well-formed connective tissue has already settled down into strands of wavy, fibrillated bundles. At an early stage the necrotic cells look uniformly granular and gelatinous. A zone of small, darkly stained cells surrounds the necrosing area. Beyond it we find the ring of never-failing fibrous tissue, from which cicatrizing processes will spread inward when necrosis is completed and the broken-down tissues are discharged (Figs. 148 and 149).

The sections of tissues from the appended cases show all these

features. There are numerous areas where fat deposits, degenerating cells and spaces of uniform appearance without cell elements mark the areas of impending necrosis. We find them surrounded by rings of small round lymph cells and plasma cells. At the edges of the hypertrophied masses we note the presence of fibrosis in every stage of formation.

**Treatment.**—1. *Local.*—Strict cleanliness is of extreme importance. Frequent warm baths are indicated. The bathing of parts with soothing lotions (opium when there is itching) keeps them quiescent and prevents rubbing and scratching. Lotio nigra may be used freely and the perineum

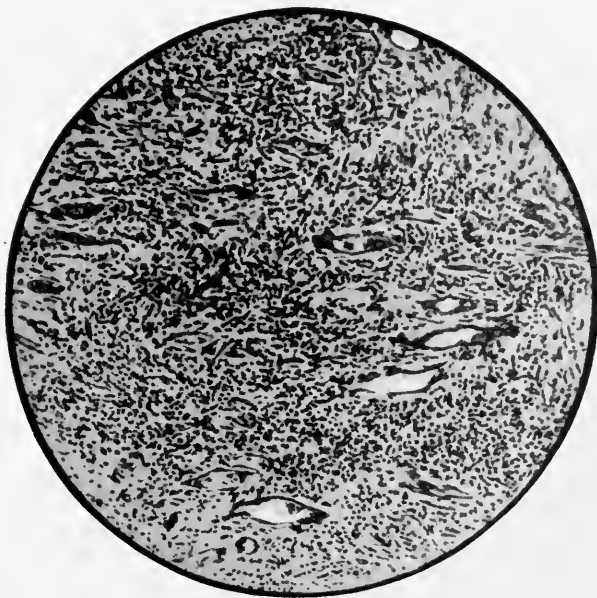


FIG. 149.—Syphilitic hypertrophy of the vulva, with ulcerations (high power). Shows inflammatory tissue of fairly recent date. The chief elements are large numbers of small round cells which form very dense masses in some parts and numerous blood-vessels. Some of these are widely dilated and engorged with red blood cells. Others have thickened walls surrounded by young connective tissue. (From Lena Kurz's article.)

should be kept as dry as possible and dusted with borax and calomel powder. Ulcers should be touched with 5 per cent. solution of silver nitrate. When there are fistulae, with incontinence of urine and feces, special care should be taken to keep the perineum clean.

2. *Constitutional.*—If possible, the patient should remain in bed until all ulceration is healed. In severe cases when there is destitution, a prolonged stay in hospital should be enforced. The object is to prevent all irritation of the parts, to enforce absolute cleanliness, to improve the general condition of health by regular and ample feeding, and to obtain facilities for consecutive medicinal treat-

ment. With such means, early and slight cases of esthiomène often yield rapidly and remain cured.

The main medicinal treatment consists in the administration of mercurials and of potassium iodide. The mode of administration, dosage, and length of period during which the medication is employed will depend on the nature and stage of each case. The salvarsan treatment should be tried whenever it is possible to employ it.

3. *Operative*.—Operative measures are frequently indicated and prove of great value when no response to medicinal treatment has been observed, when the hypertrophy is increasing, and the ulceration continues to spread. Operative treatment consists in removing the hypertrophied masses *en bloc*. Sometimes a considerable portion of the vulva has to be sacrificed. When superficial callous ulceration exists, scraping of the floor and edges is beneficial. When the ulceration is deep and burrowing, scraping is of no avail. Fistulæ cannot be closed by operations on account of the unsoundness of the neighboring tissues. Strictures, after the healing of surrounding portions, may be dilated, but this is not always successful.

Surgical treatment should never replace medicinal. Even if by operation the parts are apparently cured, antisyphilitic treatment must be persevered with for fear of recurrence.

We may here say a word on the early removal of a portion of tissue for microscopic examination. This should be done as soon as the patient comes for treatment. Such a procedure may reveal malignant disease when it is sometimes least suspected.

## 2. EROSIVE AND GANGRENOUS BALANITIS.

### THE FOURTH VENEREAL DISEASE.

**Definition.**—Erosive and gangrenous balanitis is a specific infectious disease with local and constitutional symptoms varying with the severity of the infection.

**Etiology.**—The cause is a symbiosis of a vibrio and a spirochete. These two organisms are always found together in the affection. Both have been demonstrated in sections, in the bloodvessels, and in the inguinal nodes.

*Predisposing Causes.*—1. A long, tight foreskin excluding the air to a greater or less degree.

2. Wetting the labia or penis with saliva.

3. Unnatural sexual relations after alcoholic excesses.

In private practice in this country the disease is uncommon, probably occurring once in 200 cases; but in dispensary work, in which material comes from the lower walks of life, the infection is fairly common. Scherber<sup>20</sup> reports 81 cases that occurred in Finger's clinic in four years.

**Bacteriology.**—Abundant evidence is at hand to show that in noma and in Vincent's angina the etiological factors are a spirochete and a vibrio. Róna says that "noma begins without exception in gangrenous

stomatitis. If the fusiform bacillus and spirochete found in the mouth are etiological factors in gangrenous stomatitis, since the organism is found in such abundance in noma, it must be due to the same cause."

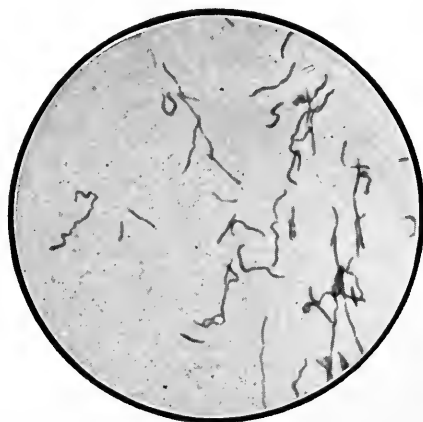


FIG. 150.—Vibrio and spirochete; culture from case of noma. Slide and culture by Dr. Ruth Tunnicliff.

In the first publication of the writer on this subject<sup>17</sup> numerous authors were cited and abundant clinical proof was obtained to substantiate the pathogenicity of these organisms.

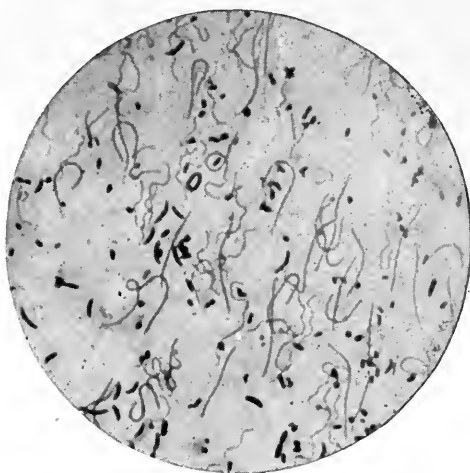


FIG. 151.—Etiological factors in erosive and gangrenous balanitis. (Author's case.)

The author has repeatedly examined the spirochetes found in Vincent's angina under the dark-field illuminator. Here the organism is identical with that found in erosive and gangrenous balanitis, the motility being one of the characteristic and diagnostic features.

Since the conditions that favor the growth of these organisms—heat, moisture, filth, and absence of air—are more ideal in the genitalia than in the mouth, it is easy to conceive how an organism may leave its normal saprophytic domain and under proper anaërobic conditions become pathogenic and produce extensive destruction.

Examinations of vaginal secretions of 100 normal women showed bacteria and spirochetes similar to those found in smegma, but no spirochetes of balanitis.

In 11 cases of clinically evident vulvitis and vaginitis, vibrios and spirochetes were found.

**Etiology.**—As shown in Fig. 151, the vibrio and spirochete are the predominating organisms found. We can easily argue, as did Róna, in 1905,<sup>18</sup> that if the fusiform bacillus and the spirochete found in the mouth are etiological factors in gangrenous stomatitis and gingivitis, erosive and gangrenous balanitis must be due to the same cause, since the organisms are found in such abundance in these conditions, and especially since in the histories of all my cases unnatural sexual relations or a wetting of the labia were admitted.

The vibrio grows under anaërobic conditions on serum-agar. It occurs single or in chains of two or more individuals. It is a slightly curved, rod-shaped organism with pointed ends, measuring about 2 microns in length and 0.8 micron in width. It stains by the ordinary dyes and is Gram-positive, although the decolorization must be performed very carefully, as the organism gives up the gentian violet readily. It is preferable to use 70 per cent. alcohol for this purpose.

The spirochete is Gram-negative, but stains with the ordinary dyes; with the Giemsa stain it takes a bluish red. These organisms are best seen with the dark-ground illuminator. They average from 6 to 30 microns in length and about 0.2 micron in width. The windings are not acute and the ends of the organism terminate in the centre of the spiral. The motion of the organisms is very rapid; they travel from place to place, resembling small snakes; they have a rotary motion, but this is not so pronounced as the backward and forward motion.

After unsuccessful attempts at animal inoculation with cultures, Scherber does not believe in the pathogenicity of the fusiform bacillus, and considers the spirochete responsible for the lesions.

A rapid and simple method of collecting the pus is by capillary attraction with small capillary pipettes. These may be pushed deep into the ulcers and a quantity of fresh discharge obtained. The pus may be examined with the dark-field illuminator, or fixed and dried and stained from two to three minutes with carbol-fuchsin. It is to be examined without cover-glass with oil immersion.

**Pathology.**—The pathological condition in the milder forms of balanitis erosiva circinata consists simply of a flaking off of the epithelium, leaving small superficial erosions. When the desquamation is more marked there are bright red ulcers, which are surrounded by a small white zone, the remains of the necrotic epithelium (Figs. 152 and 153).

In the surrounding tissue there is an exudation of leukocytes and

plasma cells. The organisms are found in the necrotic membrane. At times they can be demonstrated in the tissues and bloodvessels, as shown by Scherber and Müller.<sup>19</sup>

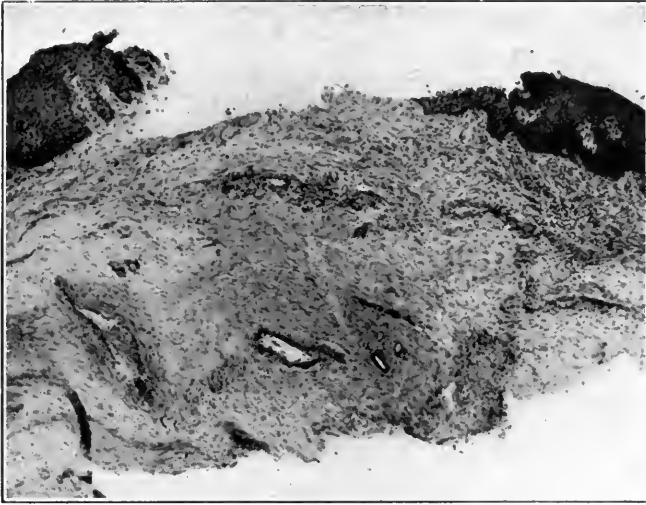


FIG. 152.—Erosive and gangrenous balanitis (low power). Shows the epithelium flaked off at the site of a small superficial erosion. There is an exudation of leukocytes but in contradistinction to chaneroid and chancre this is not marked. The vascular tissue is not increased. (Author's case.)



FIG. 153.—Erosive and gangrenous balanitis (high power). Shows a bloodvessel with moderate amount of leukocytes in adventitia. There is no proliferation of the endothelial lining or occlusion of lumen. (Author's case.)

In the more severe grades of infection there is more venous stasis and more exudation, resulting in marked phimosis, which predisposes to gangrene. As Scherber and Müller pointed out, the whole condition is one of degree only, but for clinical purposes we may distinguish two types (1) *balanitis erosiva circinata*, and (2) *balanitis gangrenosa*.

**Symptoms.**—*Balanitis erosiva circinata* commences with the appearance of one or more small, grayish-white patches in the preputial sac. At the time of the development of the erosion an offensive thin pus is produced of a characteristic stinking odor and of the usual yellowish white; in the more severe cases it becomes grayish white or grayish brown.

Pus from the lesions is innocuous. In its development the inoculation never becomes pustular, but necrosis of the epithelium always represents the beginning, and the future process is polycyclic.

Infection shows a preference for the sulcus coronarius, next on the inside of the prepuce, and last on the glans. In development all of the glans penis is involved, and under favorable anaërobic conditions the whole fossa navicularis is affected. It must be borne in mind that more or less phimosis is an essential factor.

In the mild cases the foreskin may be easily retracted, but in the more severe forms marked phimosis develops; there is considerable itching and burning behind the glans; the act of urination is practically without pain. In contradistinction to the gangrenous form, in this type of the disease constitutional symptoms are slight or absent.

As the process follows no hard-and-fast lines, there are certain deviations from the foregoing picture. The process may be limited to the glans and the inner surface of the foreskin may be unaffected. This may be extreme or mild, but it is always present on the covered portion of the glans.

The inflammatory condition may remain a purely erosive, superficial process and may recover spontaneously. Berdal<sup>16</sup> says that in simple cases healing takes place in four or five days. Scherber has seen spontaneous healing almost completed in forty-eight hours by simple washing and admission of air by retracting the foreskin. He further states from observation that the height of the development usually occurs in from four to eight days after exposure to infection, and that he had seldom seen cases of four weeks' incubation and cases persisting for three or four weeks.

In a number of cases the process does not remain superficial, but develops deep diphtheritic and gangrenous ulcers, which complicate the clinical picture in many ways.

In some cases, when the foreskin can be retracted, after removal of the pus, small, round ulcers can be seen inside of the erosions, varying in size from that of a pin-head to that of a pea. These ulcers are moderately deep and, on the whole, flat and surrounded by a red zone. They are covered by a closely adherent pseudomembrane. In other cases the ulcers are more extensive and deeper, the average size being about that of a dime. These may become confluent and extend over the whole surface of the sulcus or the inner surface of the foreskin.

These balanitic ulcers are of a somewhat irregular outline, and are surrounded by small inflammatory, slightly elevated borders. These borders are clean cut and the sides somewhat slanting; the bases are uneven, with a firm yellowish-white or yellowish-brown membrane, which is often edematous and swollen. When more edematous, this false membrane appears as a sort of friable slime. Here and there may be hemorrhagic spots which sometimes give rise to hemorrhages from the base of the ulcer.

In the severe forms the constitutional symptoms are more marked. Scherber and Müller noticed chills and fever in a majority of their cases, and at the onset, vomiting. The average temperature ranges from 100° to 101° F. There is marked edema, the external skin being red and edematous; the infiltration may extend to the root of the penis in some cases. The dorsal lymph cord is usually palpable and the inguinal nodes are enlarged, but not painful. Unless the phimosis is complete there is no pain on urination; when, however, the urine is not able to pass freely and dilates the preputial sac, there is considerable pain.

The discharge is the most profuse in this type of the disease. By gently irrigating the preputial sac with sterile water and wiping the external urethral orifice, gonorrhea can easily be excluded by using the two-glass urine test.

In the majority of cases of balanitis gangrenosa, there occurs a marked edema of the subcutaneous tissue of the penis which extends to the root and causes a marked phimosis. If the ulcer is situated on the inner surface of the foreskin, it shows externally as a dark, bluish-red area within the surrounding bright red inflammatory tissue. The congestion and abnormal pressure, due to edema, favor the progress of the disease.

Soon the foreskin over the ulcer becomes black, and a complete necrosis of the part occurs. If the ulcer is situated on the glans, in a short time it may produce complete destruction of the glans or may even cause an extremely rapid gangrene of the organ, which may extend even to the root of the penis, as may be seen by the author's fourth case, herein described.

The ulcers in these cases are deep, the edges sharp and perpendicular, the base grayish green or brownish; or the penis may show hemorrhagic areas or be changed into a black necrotic mass.

The discharge at this time is more offensive than in the erosive type; it is grayish yellow or yellowish brown, and at times it may be slightly hemorrhagic, but always with the same characteristic odor. The inguinal nodes are enlarged; there is a mild grade of sepsis present, and general malaise is marked. There may be vomiting and the temperature may reach 104° F. The tenderness of the part is extreme.

**Diagnosis.**—This disease is not so uncommon as one might suspect. Unfortunately it is usually mistaken for chancroidal infection. The period of incubation may be the same in the two conditions; but with the characteristic thin yellowish-white, offensive discharge, in which one

finds a vibrioform organism and a spirochete, the diagnosis should not be difficult.

The ulcers of the two forms of infection may simulate each other very closely. In this form of balanitis, when the infection is at all severe, there is marked phimosis and considerably more inflammatory reaction. The enlarged inguinal lymph nodes are painless, while with a very insignificant chancroidal sore a suppurating bubo is often present.

Chancroidal ulcers are, as a rule, multiple, but they do not spread with great rapidity as do those of the ulcerative form of balanitis. Whereas the borders of the ulcers in both diseases have a clean-cut, punched-out appearance, there is greater tendency to undermine the wall in a chancroidal infection.

On account of the indolent adenopathy that accompanies balanitis erosiva, it must be differentiated from syphilis. In syphilis the period of incubation is longer, although the two infections may occur simultaneously, as reported in one of Scherber's cases, as well as in one of my own. When such a condition exists, we may be compelled to defer our diagnosis of syphilis until the period of incubation for syphilis has elapsed; or in case of a mixed lesion, the *Spirochæta pallida* may easily be demonstrated by the dark-ground illuminator, and is so characteristic as to be easily differentiated from the spirochete of balanitis.

Herpes præputialis always occurs as groups of small insignificant vesicles in which local reaction is mild or entirely absent. This condition simulates the mild form of *balanitis erosiva* somewhat, but in herpes one fails to find the organisms characteristic of balanitis.

**Treatment.**—As a prophylactic measure, the practice of circumcision should be encouraged; it is absolutely impossible for balanitis to exist in a person who has been circumscribed.

In many cases in which the condition is mild and the foreskin can easily be retracted, all that is necessary is a thorough cleansing; but in the mild ulcerative forms in which there is the slightest evidence of phimosis, a dorsal incision should be made. As the organism of balanitis is anaërobic, this incision serves the twofold purpose of admitting air and of exposing the diseased parts for treatment.

The natural tendency in this disease is to burn all the sloughing ulcers, but such treatment subjects the patient to needless punishment. As said before, the organisms of the disease are anaërobic, and as hydrogen peroxide liberates oxygen when in contact with organic matter, it acts as a specific for this form of infection.

The ordinary 2 per cent. solution is sufficient, but in severe cases of gangrenous balanitis stronger solutions of peroxide may be procured and painted on the parts.

#### REPORT OF CASES.

CASE I.—Erosive type (Fig. 154), previously reported.

*History.*—The patient, M. M. W., aged forty years, married, denied all previous venereal history. After four days' incubation the patient

noticed itching and burning around the glans penis. There were no constitutional symptoms. During the first week this continued as a mild balanitis. The patient was able to retract the foreskin. Treatment was neglected. At the end of the first week conditions suddenly became worse; the foreskin began to swell and the patient was unable to retract it. At this time he presented himself for examination.

*Examination.*—The general muscular development was good; there were no scars or evidence of previous venereal disease. The penis was swollen and edematous; the edema extended about half-way up the shaft of the penis, giving it a pear shape. The skin over the glans portion was red and slightly injected. There was complete phimosis. Exuding from the opening was a thin, yellowish-white pus, with a penetrating odor; in the pus a vibrio and a spirochete were found. There



FIG. 154.—Erosive type, Case I. Balanitis erosiva foreskin not retracted; ulcers seen on margin. (Author's case.)

was constant burning pain, which was increased on the slightest pressure. There was no urinary pain. The dorsal lymph cord was easily palpable; the inguinal nodes were enlarged but not tender. There was no fever.

*Treatment.*—With a small hard syringe 2 per cent. hydrogen peroxide was injected every hour into the preputial sac. By the second day the foreskin could be retracted, showing numerous small ulcers with sloughing bases and sharp borders, involving the sulcus and the covered portion of the glans.

These healed rapidly under the above treatment.

CASE II.—Erosive type, complicated by syphilitic infection.

*History.*—C. E., male, aged nineteen years, single. No previous venereal disease; gives history of many exposures. Last exposure four

days previous; unnatural relations. After six days of incubation, patient presented himself at my clinic at the Post-Graduate Hospital.

*Examination.*—Well-developed individual; general examination negative. Pulse and temperature normal. No enlargement of the lymph nodes; profuse yellow discharge from the preputial opening. Moderate amount of phimosis present. Foreskin was retracted with little difficulty, showing numerous typical superficial erosive ulcers, both in the sulcus coronarius and on the glans penis. Complicating this, however, was a hard, indurated, erosive chancre seen just back of the corona on the left side. The sulcus was filled with purulent discharge, as seen in Fig. 155.



FIG. 155.—Erosive type, complicated by syphilitic infection, Case II. Foreskin retracted; grayish purulent secretion in sulcus coronarius and a few small erosions on the glans. (Author's case.)

By examination with the dark-field illuminator it was possible to make a differential diagnosis at once, for there were present the *Spirochaeta pallida*, the spirochete of erosive and gangrenous balanitis, and numerous vibrios. No other method could have given such prompt diagnosis.

*Treatment.*—Two per cent. hydrogen peroxide and salvarsan with prompt resolution of erosive condition.

CASE III.—Erosive type; more advanced stage.

*History.*—F. P. E., male, aged twenty-one years, single, private patient. No history of any previous venereal disease; incubation six

weeks (patient's statement), at which time unnatural relations were had with the idea of avoiding exposure by the ordinary channels.

*Examination.*—Large, corpulent individual; general examination negative: Pulse and temperature normal. Considerable phimosis present; penis slightly swollen. Extreme tenderness on examination. Foreskin was not retractable; patient stated that during the month previous there was a little itching behind the glans, but that twenty-four hours before presenting himself for examination it suddenly began to swell and was extremely painful on examination. Profuse stinking discharge. Dorsal lymph cord was palpable; slight, painless inguinal adenopathy was present.



FIG. 156.—Erosive type, more advanced stage, Case III. Foreskin retracted after dorsal incision; deep erosive ulcers with necrotic bases just back of the sulcus coronarius. (Author's case.)

*Operation.*—Dorsal and ventral incisions were made, showing both superficial and necrotic ulcers present at borders of glans and sulcus coronarius, as seen in Fig. 156. Numerous vibrios and spirochetes were obtained from the necrotic ulcers.

*Treatment.*—Two per cent. hydrogen peroxide, thorough cleaning with hand syringe every two hours; prompt recovery; unable to obtain second photograph. There is no doubt that this case would have gone on to gangrene had not prompt treatment been instituted.

CASE IV.—Erosive type.

*History.*—P. O. S., male, aged twenty-six years. History of previous gonorrhea. Unnatural relations were held thirty-six hours previously.

*Examination.*—Typical pear-shaped swelling of the penis, foreskin retracted. Whole of glans penis and sulcus coronarius covered with superficial ulcers; average size about the head of a pin; profuse

purulent discharge, containing vibrios and spirochetes. Dorsal lymph cord palpable; no adenopathy.

This patient was so slovenly and careless that after two days of marked improvement he discontinued treatment and had a recurrence, with a later cure.

CASE V.—Erosive type; previously reported.

*History.*—M. W. M., male, aged twenty-six years. Denied syphilis; had had a supposed chancroidal infection two years previously. Two weeks before presenting himself the patient had intercourse. After three or four days there was a little itching beneath the prepuce. At the end of six days he presented himself for examination.

*Examination.*—The temperature and pulse were normal. The general nutrition was good, and there were no signs of latent syphilis. There was a large indurated swelling of the penis. From the preputial orifice exuded a thin, yellowish-white, stinking discharge. This was examined for gonococci, but none were found. There was phimosis, but it was not complete. With dilatation, the finger was gently passed between the foreskin and the glans. The whole covered portion of the glans and the inner leaf of the foreskin were covered with small ulcers, having necrotic, sloughing bases. Those on the inner leaf extended to the border of the preputial fold; by gently pulling back the foreskin the whole could be plainly seen. The dorsal lymph cord could be easily felt and the inguinal nodes were enlarged but not tender. There were no constitutional symptoms.

*Treatment.*—The patient was given a wash of hydrogen peroxide, full strength (2 per cent). As he did not return to the clinic it is presumed that his condition was satisfactory.

CASE VI.—Gangrenous type, previously reported.

*History.*—The patient, A. G. G., male, aged forty-three years, denied all previous venereal history. He had had intercourse nine days previously; at this time the patient said that the prostitute lubricated the labia with saliva. The following day the glans portion began to swell; there were chilly sensations; no nausea or vomiting. Previous to this time the patient's glans penis was exposed between the preputial fold, and the foreskin could be retracted. On account of the rapid phimosis that developed this could not be accomplished later. The local symptoms increased rapidly; by the third day gangrene had set in.

*Examination.*—When the patient presented himself at the clinic he was well nourished; muscular development good. There was a slight septic intoxication. The entire preputial covering for a distance of three inches was a black, necrotic mass (Fig. 157). By gentle manipulation the necrotic mass could be drawn away and deep sloughing ulcers, with sharp borders, could be seen extending into the penis above the glans. There was considerable thin, slimy pus present, with an odor of necrotic tissue. Here we were able to find the organism in large numbers. The remaining portion of the penis was dark red and infiltrated, the edema extending to the root; the inguinal lymph nodes were enlarged. The patient's temperature was 102° F.; malaise was marked.

*Treatment.*—The patient was sent to the County Hospital. Here the necrotic foreskin was cut away, and just above the glans portion,



FIG. 157.—Gangrenous type, Case VI. Appearance on examination. (Author's case.)



FIG. 158.—Gangrenous type, Case VI. Appearance forty-eight hours later. (Author's case.)

## DIFFERENTIAL DIAGNOSIS BETWEEN SYPHILITIC CHANCER, CHANCROID, HERPES, AND EROSIIVE AND GANGRENOUS BALANITIS.

	Syphilitic chancre.	Chancroid.	Herpes.	Erosive and gangrenous balanitis.
Etiology	<i>Spirochaeta pallida</i>	Ducrey-Unna bacillus	No organism	Symbiosis, vibrio and spirochete.
Incubation	Fourteen to twenty-one days	Two to five days	None	Three to five days; may be longer.
Location	Generally on genitals; may be anywhere	Generally on genitals; rarely elsewhere	Generally on genitals; may be anywhere	Always on glans penis behind closed foreskin; may extend to adjacent parts.
Number	Usually single, but may be double; must be so from onset	Usually multiple; may develop additional ulcers at any time during activity of infection	Usually multiple, later confluent	Usually multiple.
Auto-inoculable	Possible up to ten days	Possible at any time	No	Only possible under anaërobic conditions.
Onset	Starts as erosion or papule	Pustule or ulcer	Group of vesicles	Small, superficial erosion.
Course	Remains as erosion or ulcerates.	Ulcer extends	Forms superficial ulcer	Becomes confluent; rapid coalescence.
Induration	Usually present	Rare	None	Slight.
Pain	Little or none	Very painful	Burning and itching	Very painful.
Shape	Round or oval symmetrically, irregular	Round or oval unsymmetrically, irregular	Irregularly rounded, border polycyclic	Irregular round or oval; border polycyclic.
Depth	Superficial, cup-shaped or saucer-shaped; may be elevated	Deep, excavated or punched out	Superficial	Superficial at first, may extend deep.
Surface	Smooth and shining; darkish red membrane frequent	Rough, moth-eaten, grayish, warty appearance	Bright red superficial granulation	Rough necrotic centre; slightly reddened border; may be yellowish-brown membrane.
Edges	Sloping, but may be elevated	Clean cut, may be undermined	Sharp, not undermined	Clean cut; not undermined; somewhat slanting sides.
Bottom	Smooth and shining	Uneven and irregular; no luster	Bottom even; diffuse inflammatory tissue	Gray and irregular; no luster.
Secretion	Slight unless irritated, then profuse; serous	Abundant and purulent	Slight, seropurulent	Profuse, stinking, gray to grayish-brown discharge.
Adenitis	Constant; indolent	When present, always inflammatory	No glands	Constant, indolent.
Gangrene	Rare, unless complicated by erosive and gangrenous balanitis	Rare, unless complicated by erosive and gangrenous balanitis	Never	Often.

at the site of the inner preputial fold, two deep ulcers could be seen. The glans portion was necrotic. In forty-eight hours (Fig. 158) the entire glans, together with about one and a half inches of the shaft of the penis, sloughed off, leaving a short stump (Fig. 159). The patient was treated with irrigations of potassium permanganate three times a day, but the organism had already invaded the deeper layers, and gangrene was unavoidable.



FIG. 159.—Gangrenous type, Case VI. Appearance five months after, showing small stump left. (Author's case.)

### B. NON-VENEREAL GENITAL ULCERS.

1. Ulcers accompanying diabetes found on the glans penis of the male and on the vulva of the female, usually shallow without inflamed edges.
2. Ulcers accompanying infectious diseases.
  - (a) In measles, usually in little girls.
  - (b) In diphtheria caused by the specific bacillus. Rare in the male, but sometimes found on the penis. In the female found chiefly on the inner side of the labia and on the clitoris. In appearance like venereal ulcers, but distinguished by the bacterial findings.
  - (c) In typhus fever, also more frequent in the female.

- (d) Tuberculous ulcers; rare in the male, more frequent in the female; usually secondary to tuberculosis in neighboring organs, but may be due to direct infection. The ulcers are shallow, with their edges but little inflamed, showing numerous dentations. The base of the ulcer is usually clear and granulating, containing small grayish nodules.

3. Ulcers which are due to localization of skin diseases on the genitals.

**Herpes Progenitalis.**—These ulcers are round or oval, with thin edges often showing the characteristic grouping of herpes, but not invariably. Found in the male on the prepuce, glans, or sulcus; in the female mostly on the labia.

**Etiology.**—*Predisposing Causes.*—It is said to be more common in those who have venereal diseases. Phimosis with retained secretions and coitus are exciting factors. Males and females are equally affected. Bergh<sup>11</sup> claims that it is more frequent in women at the time of menstruation.

Herpes progenitalis, the same as herpes in other parts, is due to a peripheral neuritis, and may depend on reflex irritation of neighboring ganglia due to local or internal secretions.

**Symptoms.**—Herpes progenitalis begins as a single lesion or in groups, the same as are seen on the face or lips. Slight burning and itching are first noticed, and the slightly red area soon develops minute vesicular points, which rapidly increase in size to that of a pin-head or slightly larger. Frequently these lesions become chafed, causing rupture of the vesicles, the area becomes confluent or presents several small excoriated areas which become irritated by secretions and slight infections of ordinary pathogenic organisms.

**Diagnosis.**—In an individual recently exposed sexually, presenting a confluent patch of herpes that have become excoriated, the diagnosis should not be attempted without a careful examination for spirochetes. In the early cases, however, the distinct vesicles, rapid onset, and absence of glandular swelling should be conclusive.

**Treatment.**—*Prophylactic.*—Where phimosis is present, circumcision should be performed. Frequent washing of the parts should be attended to. As this condition is self-limited, in the doubtful cases where there is any question of a diagnosis, all treatment should be withheld. Where the diagnosis is positive, however, simple ointments or dusting powder are satisfactory.

### 3. CHANCROID.

**Synonyms.**—Simple ulcer; simple venereal ulcer; soft chancre or *ulcus molle*.

**Definition.**—A specific infectious ulcer usually acquired during the sexual act, almost always situated upon the genitals, but may be found on any part of the body.

**Etiology.**—A. *Predisposing Causes.*—(1) Race—most frequent among colored people. (2) Phimosis, causing retained secretions.

(3) Filth and poverty and debauchery and degeneration go hand in hand with this infection; as a consequence, it is more frequent in dispensary practice than in private work. During the author's five years' experience at the Post-Graduate Hospital, situated in the centre of Chicago's "red-light" district, he was particularly struck by its frequent occurrence in the colored race. (4) Poor and ill-nourished individuals do not resist the infection well.

**B. Exciting Cause.**—Ducrey-Unna bacillus.

**Description.**—It is a short rod-shaped bacillus with slightly rounded extremities, occurs often in chains, sometimes in groups, either in cells or between them, and is readily stained with methylene blue, carbol-fuchsin, or borax-methyl-violet. It is decolorized by Gram's method.

On account of the contamination by extraneous organisms, the demonstration of the Ducrey-Unna bacillus is difficult; however, if the ulcer is sealed with flexible collodion for twenty-four hours to kill all the extraneous organisms, the finding of the bacillus should not be difficult.

**Pathology.**—Microscopically, there is found at the bottom of the epithelial erosion an infiltration of leukocytes, which extends laterally only a little beyond the hyperemia. The exciting cause of the ulcer, the delicate and difficult to stain little rods (Ducrey-Unna bacillus) line the tissue. These bacilli make their way out from the hyperemic area along the course of the lymph spaces into the lymphatic channels; as these lie open with unobstructed lumen, the rapid march of the infection to the neighboring glands is the rule (Figs. 160 and 161).

As a consequence of secondary infection with other bacteria gaining entrance through the local ulcer, an extended necrotic disintegration can reach into the surrounding tissue. This may extend both laterally and deeply and lead to wide destruction of tissue. Such a condition is known as phagedena. Occasionally the lymphatics that drain a given ulcer appear as red streaks or lines, passing backward to the regional lymphatic glands. These are easily palpable and may be quite painful.

**Symptoms.**—Incubation twenty-four hours to three days; occasionally five to nine days are given by the patient; at this time, however, the ulcer is well advanced.

After sexual indulgence, with varying periods of incubation, a small congested spot makes its appearance; this rapidly forms a small macule which later develops into a pustule, surrounded by a hyperemic zone. This usually increases rapidly in size, the superficial layer of the cutis is either pulled off or falls off, revealing an ulcer, the exact size of the superficial crust.

These ulcers are deep and have a characteristic punched-out appearance. The edges are steep and are frequently undermined. The floor has a dirty gray, moth-eaten appearance, and, until this dirty gray, sloughing base is replaced by granulation tissue, healing will never occur. The discharge is purulent, profuse and may be bloody at times.

Constitutional symptoms are absent and remain so unless there is lymphangitis or inguinal adenitis.

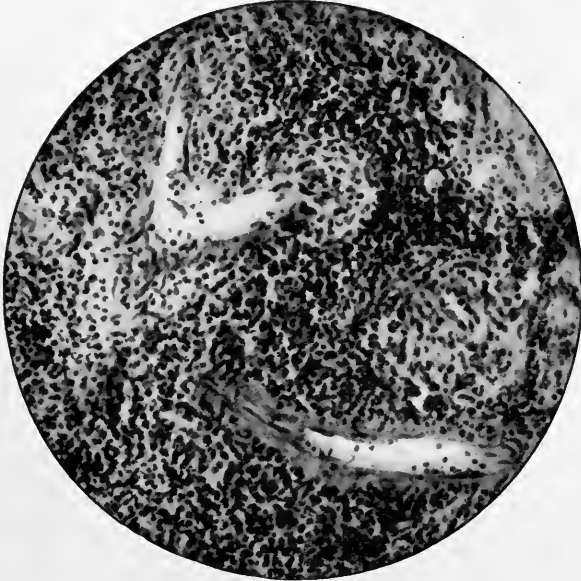


FIG. 160.—Chancroid (low power). Shows infiltration of stroma with lymphoid cells and polymorphonuclear leukocytes. No increased vascularization. No infiltration of bloodvessel walls. (Author's case.)



FIG. 161.—Chancroid (high power). Shows bloodvessels with polymorphonuclear leukocytes in lumen, but no thickening of walls.

*Pain.*—In contradistinction to the specific lesion of syphilis, chancroidal ulcers are extremely painful and are capable of auto-inoculation, often spreading to a great extent. A single ulcer is seldom seen; multiplicity is the rule.

*Location.*—The ulcers are, generally, confined to parts where the greatest friction during coition takes place. In the female, the labia or vestibule is most frequently involved; occasionally the external urethral orifice is the site of infection. In the male, abrasion or tears take place most frequently in the sulcus coronarius, around the frenulum, at the edge of the prepuce and the external urethral orifice. These places are the sites of predilection. When the ulcer is situated at or within the external urethral orifice, urination is always painful. Occasionally a gland follicle becomes the site of infection; here the ulcers may burrow deep and undermine the surrounding tissue and the gland opening may be the smallest part involved.

*Mixed Sore.*—It is indeed common to find both chancroid and chancre in the same individual, either in the same ulcer, or in different ulcers. Often an inflammatory hardness is present in chancroid that simulates the induration of the specific chancre.

*Diagnosis.*—There is no single condition that receives such careless attention as do simple ulcers that occur on the genitals. Few observers realize the importance of an exact diagnosis, especially if the infection is syphilitic. Unfortunately, the Ducrey-Unna bacillus is difficult to find and is little known in this country. Fortunately, however, a diagnosis can be reached by exclusion, which is just as accurate and more rapid than finding the exciting cause of chancroid itself. Every genital ulcer should be examined carefully for the *Spirochæta pallida* and search continued diligently until the presence of the organism is excluded before any mutilation or treatment is practised in the way of cauterization, dusting powders, etc. There is no longer any excuse for haphazard diagnosis in genital ulcers. It is true that clinical appearances, multiplicity, lack of induration, etc., may be clear and characteristic, but no one should permit an ulcer to come under his care without a thorough microscopic examination.

In most American text-books frequent reference is made to gangrenous conditions that often accompany chancroid. This condition, described in detail in the latter part of this chapter, is caused by a symbiosis of specific organisms. Here careful microscopic examination with the clinical history will permit of an exact diagnosis. For further discussion on the diagnosis of chancroid, see Chapter on Syphilis.

Herpes, occurring on the genitals, is often mistaken for chancroid infection, unless seen during the vesicular stage; these erosions are superficial, have little discharge and are not painful. Lymphangitis and adenitis are lacking; microscopic examination is negative.

While the Wassermann reaction, the technic of which can be found in any modern text-book on clinical diagnosis, is absolutely valueless as far as an early diagnosis is concerned, occasionally an ulcerated

papule or chancre redux (see description) may simulate chancroid infection. Here the application of the test should be a valuable aid in diagnosis; however, the fact should not be lost sight of that the consumption of large quantities of alcohol just before the test is made may cause a negative reaction and the test prove worthless.

**Treatment.**—*Prophylaxis.*—The wearing of a condom during the sexual act is the most reliable preventative; thorough cleansing with soap and bichloride (1 to 5000) may be employed; however, the latter will not always prevent infection.

It should be borne in mind that no treatment of any kind should be instituted until an accurate diagnosis is made; then treatment should be prompt and efficient.

As the exciting organism lies deep in the tissues, cauterization has been the favorite method of attack for years, and it is rather strange that so many different caustics and methods of application should be recommended. Taylor, as cited by Watson and Cunningham,<sup>14</sup> recommends the application of liquefied phenol, followed immediately by the application of nitric acid. Care should be taken to use considerable pressure and to undermine the edges, without touching any of the healthy skin with the caustic. This is a favorite method of the author.

By applying the phenol first, considerable local anesthesia is produced, so that the subsequent burning with nitric acid is not so painful. Under no consideration should phenol or silver nitrate be used alone, as only the superficial portion of the lesion is scarified, underneath which infection is sealed up and a resulting adenitis is rapidly manifested.

Iodoform as a dusting powder is superior to all others; its odor may be destroyed by cumerine, gr. ij to ʒj, or by placing in the bottom of a stocking or tobacco pouch ground coffee, over which a layer of cotton is placed. The affected part is then dusted with iodoform and tied into the sack.

A favorite and efficient ointment that may be applied is the following:

Iodoform . . . . .	2.5
Balsam of Peru . . . . .	5.0
Petrolatum . . . . .	50.0

The use of dusting powders is pernicious and is to be condemned, as most of them have no real antiseptic properties and only tend to crust over the lesion and hasten absorption, with resulting adenitis.

Morton recommends the chloride of zinc pulp, which is prepared by adding a few drops of water to chloride of zinc.

A favorite method in some hospitals is the continued application of phenol, neutralizing each application well with alcohol.

Chancroid, situated at the urethral orifice, should not be cauterized, if it is at all possible to cause its healing without so doing.

**Complications.**—1. *Phimosis.*—This condition is a common and often troublesome complication of chancroid; the condition *per se* is not so

serious as the delay in the diagnosis of the ulcer that is causing the condition. Often it is possible to retract the skin enough to obtain material for diagnosis. However, when this cannot be accomplished, prompt incision and exposure of the ulcer is recommended. It is true that the line of infection may become infected if chancroid is present, but the patient, on the other hand, may be saved from the period of secondary syphilitic invasion, and this is worth while.

It is possible in some cases to cause a resolution of the condition by immersing the glans in hot water and irrigating with hydrogen peroxide.

Ten per cent. iodoform in glycerin is recommended as an efficient method. However, all palliative treatment should be discouraged until a positive diagnosis has been made.

2. *Paraphimosis*.—Occasionally this condition is seen associated with genital ulcers. Contrary to the condition of phimosis, there is no obscuring of the etiological factor, and after a diagnosis has been made, either incision of the constricting band or manual reduction can be resorted to.

3. *Phagedena*.—Before the days of antiseptic surgery, phagedena was a very formidable complication of chancroid. Its etiology was little understood. We have come to know that the Ducrey-Unna bacillus is always present, associated, as a rule, with the streptococcus, although almost any pyogenic organism may be found at times. Numerous text-books still confuse phagedena with gangrenous conditions that occur around the glans penis. It must be distinctly understood that this form of gangrene has a distinct and separate bacteriology (see Erosive and Gangrenous Balanitis), and should no longer be mistaken for phagedena.

*Treatment*.—As this condition is almost always associated with debility and malnutrition, tonics and supportive treatment should be instituted. Locally, the ulcers must be cauterized, so that nothing but healthy tissue remains. At times it may be necessary to use the actual cautery. A continuous hot-water bath, either by means of the sitz-bath or immersion of the organ in a vessel of hot water, greatly facilitates resolution and repair.

**Sequelæ.**—(1) Lymphangitis; (2) lymphadenitis.

Lymphangitis always accompanies chancroid infection in a greater or less degree, and in the milder form needs no treatment. However, in debilitated individuals, sometimes this is very severe and distressing. Continued hot soaking or hot, moist applications should be employed, and if softening and fluctuation become manifest, incision should be promptly made.

## INGUINAL ADENITIS OR INGUINAL BUBO.

This is a frequent and severe complication following chancroidal infection.

**Etiology.**—1. *Predisposing Cause.*—The condition occurs frequently among the poor, laboring classes, who attend the free dispensaries, for among them heavy lifting and walking predispose to the infection. Among the better class of patients, inguinal adenitis is rather infrequent.

2. *Exciting Cause.*—The exciting cause is the Ducrey-Unna bacillus. The chancroidal form of infection invariably causes an inguinal adenitis unless the primary infection is attended to promptly.

**Symptoms.**—The adenitis generally occurs in the second or third week of the chancroids, unless the ulcers have been carelessly cauterized, in which case it occurs earlier. If the ulcer is on the right side, the right inguinal glands become involved; if on the left side, the left side is involved; however, when the ulcer is on the frenulum, or on both sides, either or both sides may be involved.

Pain is the first symptom that attracts the patient's attention, and this is increased with walking or the slightest exertion.

On palpation the individual inguinal glands that run parallel to Poupert's ligament are easily identified. The glands are hard and very tender while the skin over the mass is slightly congested and freely movable. At this period the glands may either undergo resolution and recede or the condition may become progressively worse. Considerable peri-adenitis occurs, the glands become matted together in irregular, tender masses and adherent to the skin and the subjacent tissue; the former becomes boggy, dusky red, and edematous, and softening occurs rapidly, in some cases with spontaneous rupture. Frequently the exact counterpart of the chancroid is depicted in an inguinal adenitis. The base of the suppurating glands is dirty gray, and there is extropion of the walls with undermined edges (virulent bubo).

On cross-section, such a gland shows numerous miliary abscesses. Some, of course, undergo resolution, but many break down, become confluent, and leave the whole gland as an abscess cavity, with the gland capsule alone as the limiting membrane. Occasionally, the extension of a phagedena into the inguinal adenitis is seen, forming a serpiginous ulceration.

**Treatment.**—*Prophylactic.*—The prompt and early surgical treatment of all chancroidal ulcers (see Treatment under Chancroid) should be resorted to. Never cauterize the chancroids with silver nitrate or phenol alone, as these both tend to seal over the top of the ulcer and cause absorption from the under strata, which invariably produces an adenitis in twenty-four hours.

*Palliative.*—The sore having been previously cleansed and cauterized, the parts are shaved and scrubbed, hot bichloride (1 to 5000) or boric acid dressing are applied, the patient is bandaged firmly with a spica bandage and put to bed.

This hot dressing is changed every two or three hours. This procedure, with rest in bed, will cause both resolution in the glands that are not too far involved and will hasten softening in those that are far advanced. Continuous wet alcohol dressings, in the same manner that the wet bichloride dressings are applied, may help to cause resolution in some cases. Hyperemia applied after the method of

Bier by means of a bell glass is admirable to promote resolution and hasten softening. The common practice of painting the parts with tincture of iodine has little or no value.

*Surgical.*—This treatment should be withheld until the bubo has softened and there is fluctuation; then simple incision at right angles to Poupart's ligament offers the best method of drainage. The wound is wiped dry and packed with iodoform gauze. Frequent swabbing with tincture of iodine and dressing with wet or dry gauze offer the best means of causing resolution.

Except for the management of chancroid itself, no other condition has received so many diverse forms of treatment. Complete extirpation of the glands is a favorite method of radical cure, but unfortunately being septic in the beginning, these wounds do not heal kindly, and occasionally grave complications arise from wounding of deep-seated bloodvessels and lymphatics.

Frequently the chancroidal adenitis may be complicated with the indolent adenitis of lues, and here the application of prompt and energetic specific treatment, as a rule, causes rapid resolution.

Phagedena as a complication of adenitis calls for heroic treatment. The patient is best anesthetized, and with the actual cautery all infectious and necrotic tissue is removed; subsequently the ulcers are treated with hot dressings and tincture of iodine irrigations.

#### BIBLIOGRAPHY ON GENITAL ULCERS.

1. Bergh, R.: *Monatsh. f. prakt. Dermat.*, 1890, x, 1.
2. Craig, C. F., and Nichols, Henry: *War Dept. Bull.* No. 3, June, 1913, p. 51.
3. Doinikow, Boris: *München. med. Wehnschr.*, 1913, lx, 796.
4. Dreyfus, Georges L.: *München. med. Wehnschr.*, 1912, lix, 2567.
5. Ehrlich, P.: *Ztschr. f. Chemotherap. u. verwand. Geb.*, 1912, i, 1.
6. Ellis, Arthur W. M., and Swift, H. M.: *Jour. Exp. Med.*, 1913, xviii, 162.
7. Jadassohn, J.: *Arch. f. Dermat. u. Syph.*, 1907, lxxxvi, 45.
8. Kurz, Lena: *Jour. Obstet. and Gynec. Brit. Emp.*, 1913, xxiii, 353.
9. Morton, Henry H.: *Genito-Urinary Diseases and Syphilis*, Philadelphia, F. A. Davis & Co., 1912.
10. Mott, F. W.: *The Cerebrospinal Fluid*, *Lancet*, 1910, ii, 79.
11. Noguchi, Hideyo: *Jour. Am. Med. Assn.*, 1913, lxi, 85.
12. Ravaut, Paul: *Ann. de méd.*, 1914, i, 49.
13. Schereschewsky, J.: *Deutsch. med. Wehnschr.*, 1913, xxxix, 1310.
14. Watson, F. S., and Cunningham, John H.: *Diseases and Surgery of the Genito-Urinary System*. Philadelphia, Lea & Febiger, 1908.
15. Wechselmann, Wilhelm: *Salvarsan Therapy*, 2d ed.

#### BIBLIOGRAPHY ON EROSIVE AND GANGRENOUS BALANITIS; THE FOURTH VENEREAL DISEASE.

16. Bataille and Berdal: *Méd. mod.*, 1891, ii, 340.  
Dind: *Rev. méd. de la suisse romande*, 1911, xxxi, 592.  
Ellerman: *Centralbl. f. Bakteriöl.*, 1905, xxxviii, 383.  
Kallionzis, E.: *Ἱατρικὴ προσδοκ.*, *Ἐν Σίρῳ*, 1910, xv, 385.  
McDonagh: *West Lond. Med. Jour.*, 1911, xvi, 131.  
Romeo, P.: *Gazz. d. osp.*, 1910, xxxi, 1257.  
Tunncliff, Ruth: *Jour. Infect. Dis.*, 1906, iii, 148.  
Tunncliff, Ruth: *Jour. Infect. Dis.*, 1911, viii, 316.  
Weaver, G. H., and Tunncliff, Ruth: *Jour. Infect. Dis.*, 1905, ii, 446.
17. Corbus, B. C., and Harris, Frederick G.: *Jour. Am. Med. Assn.*, 1909, lii, 1474.
18. Róna, S.: *Arch. f. Dermat. u. Syph.*, 1905, lxxiv, 171.
19. Scherber and Müller: *Arch. f. Dermat. u. Syph.*, 1905, lxxvii, 77.
20. Scherber: *Handbuch der Geschlechts-Krankheiten*, 1910, i, 153.

## CHAPTER IX.

### INFECTIONS OF THE URETHRA AND PROSTATE OTHER THAN TUBERCULOSIS.

By B. S. BARRINGER, M.D.

#### GONORRHEA.

**Prevalence of Gonorrhea.**—It is highly probable that every male who indulges in promiscuous intercourse sooner or later acquires a gonorrhea. The percentage of males so affected varies according to different authorities, and according to various countries between 50 and 100 per cent.

"Morrow estimates that 60 per cent., and Forscheimer that 51 per cent. of the adult male population of the United States have gonorrhea. He adds that 20 per cent. of these young men will become infected before they are twenty-one years of age; over 60 per cent. before they pass their thirty-eighth year." (Keyes.) These are statistics of nine years ago. Another specialist says, "roughly speaking, one may say that most German men have had gonorrhea; and one in five, syphilis."

"Blanchko calculates that among clerks and merchants in Berlin between eighteen and twenty-eight years of age, 45 per cent. have had syphilis and 120 per cent. have had gonorrhea; in Breslau 77 per cent. have had syphilis, 200 per cent. have had gonorrhea. (If the percentage of gonorrhea is placed at 200 per cent. the average is two attacks.)" (Flexner.)\*

"Among women gonorrhea is more severe and less common than among men. The proportion of men to women is 16 to 1. It is shocking to learn that almost one-third of the reported cases of gonorrhea occurred in married women to whom the infection had been conveyed by their husbands."

"In the United States Army, in prevalence, gonorrhea stands first (12 per cent. +); as a cause for discharge from the army it stands fourth; as a cause of death it is negligible." (Keyes.)

**Reasons for Prevalence.**—Illicit intercourse is responsible for most gonorrheas. To study the reasons for the prevalence of gonorrhea is to study the reasons for prostitution.

Flexner says: "No wonder that where practice is so general, theory has accommodated itself so far as to assume that sexual intercourse on the male's part is necessary and wholesome. Up to recent times this has been an undisputed dogma. The universality of demand has been condoned on the assumption that it represented an irresistible impulse.

\* Flexner's book "Prostitution in Europe" has been much quoted because it is remarkable and modern.

"In the first place, however strong the spontaneous sex impulse may be, it is really like any other impulse capable of restraint through the cultivation of inhibition. Except for the futile efforts of the church, European\* society has for centuries been singularly free from any such effort. Women have been regarded as inferior creatures and have accepted the status assigned them; they have therefore failed to resent masculine immorality. The restraint that might thereby be imposed upon men—be it much or little—has been generally lacking. Europe has been a man's world; managed by men and largely for men; for cynical men at that. Men inured to the sight of human inequality; callous as to the value of lower class life, and distinctly lacking in respect for womanhood."

The unrestrained masculine sexual impulse accounts for a certain amount of illicit intercourse; to this is added an artificial sexual excitation, "an artificial supply of prostitutes is created and an artificial demand is worked up."

A striking example of deliberate business organization along these lines is to be found in Paris, where close adjoining one another in the Rue Pagal are found a dance hall, a cafe, and an assignation house under one management."

**The Remedy.**—The remedy does not lie in any regulation of prostitution; in any segregation of prostitutes; in any prophylactic treatment; in any antigonorrheic vaccination; or in any conscience-solving eugenic test. Flexner says, "the women's movement will unquestionably destroy the passivity of German women in respect to masculine irregularities." This would seem to be the key to the remedy. Insistence upon the part of wives and mothers for masculine continence. The old and absurd physiological objections that masculine continence leads to various nervous disorders, even to impotence, still are widespread. Sexual education is in its infancy: "As the boy matures, the actual danger involved in immorality may be so depicted as to exert a detrimental effect; but the main remedies must continue to be from the higher motivation." In some sex teaching there exist curious practices; for instance, the young man is urged to be continent, and at the same time told how to use preventatives.

### ANATOMY OF THE MALE URETHRA.

The urethra, "the outlet of the bladder," extends from the bladder neck to the end of the penis, and is divided into a posterior (4 cm.) and an anterior (12 cm.). The posterior urethra is in turn divided into two parts: a prostatic (2.5 cm.), which runs from the bladder sphincter, or base of the prostate, through the prostate to its apex; and a membranous (1.5 cm.) part which runs from the apex of the prostate to the bulb. This pierces, is limited by, and receives fibers from the anterior and posterior layers of the deep perineal fascia. The anterior, spongy or

\* What Flexner says of Europe is true, perhaps in a lesser degree, of the whole civilized world.

penile urethra runs from the triangular ligament to the end of the penis, and is surrounded by the erectile tissue of the corpus spongiosum.

**Landmarks of the Urethra.**—The only part of the urethra visible is the meatus. By means of the urethroscope the interior of the urethra may be examined throughout its length.

**The Penile Urethra.**—The penile urethra runs from the meatus urinarius along the under surface of the penis (where it may be easily felt) to the penoscrotal angle, thence to the scrotoperineal angle, where it may be palpated by depressing the scrotum. The anterior urethra ends in the bulb whose lower limit is at a point midway between the scrotoperineal angle and the centre of the anus. This spot is the "central tendon" where the perineal muscles meet.

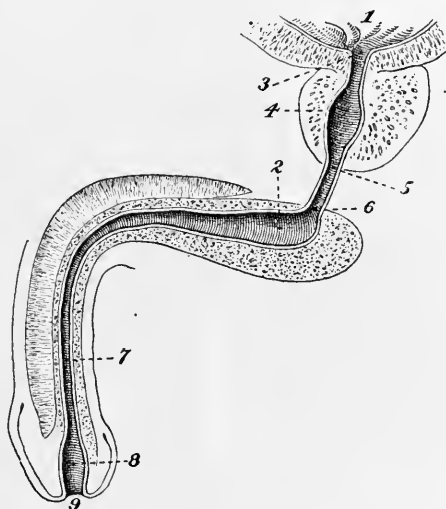


FIG. 162.—The lumen of the urethra, seen in a sagittal section; 1, bladder; 2, cul-de-sac of the bulb; 3, neck of the bladder; 4, prostatic widening; 5, narrowing at the membranous portion; 6, neck of the bulb; 7, penile narrowing; 8, fossa navicularis; 9, meatus. (After L. Testut.)

**Membranous Urethra.**—The finger introduced into the rectum will feel the membranous urethra on the front wall just behind the internal sphincter of the rectum. It runs from this point to the apex of the prostate, which can be felt farther up the rectum. If a sound is introduced into the urethra, the membranous, as well as the prostatic, portions can be better palpated. This method of palpation is especially valuable to determine the presence of an early carcinoma of the prostate which generally starts posteriorly in the lobes and is felt between the sound and the rectum.

**Prostatic Urethra.**—This runs in the median line from the apex of the prostate to its base (felt on the front wall of the rectum). The two lateral lobes of the prostate may be felt; but it takes a long finger to

reach much above the base of the prostate. The seminal vesicles are at either angle of the base of the prostate and extend upward and outward along the bladder.

**Size of the Urethra.**—The urethra begins at the vesical orifice, which is wide, usually large enough to admit the tip of the index finger, and may be dilated to 36 to 40 F. It becomes still wider in the prostate, but after the membranous urethra is reached, narrows down to 26 to 30 F. Again, in the bulb it enlarges; then narrows again in the penile portion, widens out in the *fossa navicularis*, and narrows down again at the meatus. The meatus is the narrowest and least dilatable part of the entire urethra; it averages 24 F. in size.

**Interior of the Urethra.**—The interior of the urethra is not a smooth, unbroken surface, but shows small and large indentations, and the orifices of glands.

The *indentations* of the urethra are known as the *Lacunæ* of Morgagni, and are situated in the anterior urethra, the large ones along the roof and the smaller ones along the sides. They are like pockets in the mucous membrane opening toward the end of the penis, and are from 5 to 12 mm. deep. On the roof of the *fossa navicularis* is an unusually large indentation, the *lacuna magna*.

The *ducts* of various glands enter the urethra directly or into one of these *lacunæ*. The *lacunæ* of Morgagni can be seen through the urethroscope, but the openings of the glands, if uninflamed, are generally not discernible.

**Glands of the Urethra.**—(1) The glands of Littre. (2) Cowper's glands. (3) The prostate. (4) The seminal vesicles.

The *glands of Littre* are situated chiefly along the roof and sides, a few in the floor, of the anterior urethra; and rarely in the membranous and prostatic urethra. They lie in the submucosa, are lined with prismatic epithelium, have a duct which pierces the mucous membrane obliquely, and opens toward the end of the penis. They normally secrete mucus, and on occasion stubbornly harbor bacteria. When normal, they cannot be palpated, but when inflamed, they can often be felt along the anterior urethra as nodules from the size of a bird-shot up.

*Cowper's glands* are two racemose glands as large as a bean, situated on either side of the membranous urethra just behind the bulb and between the layers of the triangular ligament. Their ducts are 30 to 40 mm. in length, run along the urethra, pierce the anterior layer of the triangular ligament, and enter the bulbous urethra; when Cowper's glands are inflamed, they can be felt with one finger in the rectum and one on the perineum on either side of the membranous urethra.

The *prostate gland* "belongs physiologically to the sexual organs," and is somewhat of the size and shape of a horse-chestnut. It lies with its base toward the bladder, its apex against the posterior layer of the triangular ligament. The urethra and ejaculatory ducts run through its substance. Its glands empty by ducts (30 or 40) into the prostatic urethra; these ducts point toward the apex of the prostate.

Lowsley<sup>3</sup> has done much work on the anatomy of the prostate, and I quote extensively from his authoritative work.

"Wilson and McGrath found the average adult gland to vary in length from 3.3 cm. to 4.5 cm., with an average of 3.4 cm. In width there is a variation from 3.4 to 4.5 cm., average 4.4 cm. Thickness varies from 1.3 cm. to 2.4 cm., average 1.5 cm. The weight averages 16 or 17 grams.

"The prostate gland is in every instance divided into five portions corresponding to the five original groups of tubular evaginations noted in the embryo. The division between the middle and two lateral lobes becomes less and less noticeable as age advances, but the orifices of the middle lobe tubules are in every instance widely separated from all other tubular orifices and quite closely grouped together. The middle lobe tubules always grow backward behind the vesical orifice outside of the broad ribbon-like sphincter of its orifice and its tubules are never found imbedding themselves in it or extending within the sphincter.

"The lateral lobes during the period of middle age become more and more prominent and cause a bulging of the lateral surfaces to a marked degree, thus making the transverse diameter of the organ proportionally greater than in prepuberty specimens.

"The posterior lobe is fairly well separated from all of the other portions of the gland and is divided off by a rather firm, and in some instances quite thick, connective-tissue partition. It is always present, as is the lobe itself, and is intimately attached to the ejaculatory ducts, which are not imbedded in this partition but seem to be set upon its anterior surface.

"The posterior lobe is always present and is the part of the gland felt per rectum. Its tubules are in most respects similar to those of the other lobes.

"The anterior lobe varies greatly in different specimens. At the time of birth it consists of two small unimportant tubules with very few branches. In the postpuberty specimens the anterior lobe is quite prominent and is made up of tubules which branch extensively and are apparently actively secreting prostatic fluid.

"The branches of tubules\* all extend backward toward the base of the prostate, with the exception of a few of the most anterior tubules of the lateral and posterior lobes. The collecting ducts are situated at the most anterior portion of a given group of branches and pass quite directly toward the verumontanum.

"In the verumontanum the tubules turn and run forward for a slight distance and about nine-tenths of them open on the lateral walls of the verumontanum, in such a manner that there is a little leaflet of tissue covering the orifice, which is an exceedingly important factor

\* Poroz<sup>9</sup> has studied the course of these ducts and concludes that they are best emptied by massaging the gland from its base downward toward its apex. Gonococci invade these ducts of the prostate, in every posterior urethritis, and it is here that they most stubbornly persist.

in protecting the tubules of the gland from an inpouring of urine and other foreign matter when the posterior urethra is put under pressure. The direction of the openings of the tubules of the prostate and ejaculatory ducts is an important consideration also, because instrumentation will frequently cause an infection by forcing foreign substances into them. In the adult prostate there is noted a great change in the mucosa. I have found in my specimens that the tubules and their branches are lined by a single layer of high cylindrical cells with the nuclei at their bases. In some places there is a piling up of the cylindrical cells. Near the orifices of the ducts the epithelium is transitional in type, being similar to that of the urethra itself.

"The capsule of the prostate is composed of a structure which is made up of closely knit connective-tissue fibers and surrounds the entire organ, except at the base between the entrance of the ejaculatory ducts into the substance of the prostate and the junction of the bladder wall with the gland. Here the tubules of the middle lobe are almost free and have as a consequence very thick muscular and connective-tissue walls. The large bloodvessels which supply the prostate, run in the capsule and intralobular partitions for the most part and are most numerous on the anterior portion of the capsule.

"The epithelium of the *vasa deferentia* is made up in part of simple ciliated columnar, and in part of stratified, ciliated, columnar cells with two rows of nuclei. The cilia are often absent, however, and vary a great deal. In the ampulla of the vas deferens the epithelium is for the most part simple columnar in type."

The *seminal vesicles* are two lobulated pouches between the base of the bladder and the rectum. They are about 7 cm. in length, and can be felt by a finger in the rectum extending upward and outward beyond the margins of the prostate. When normal, they can be felt with difficulty, and when enlarged, only the lower part is palpable.

The anterior extremities of the seminal vesicles converge toward the base of the prostate where each joins the corresponding vas deferens to form the ejaculatory ducts.

The canal system of these organs is intricate, and varies in different specimens from a simple straight tube to tubes with many twists. Either the straight or twisted tubes may have diverticula.

The blood supply is from the middle hemorrhoidal and the inferior vesical arteries which enter the vesicles at their upper and outer poles. "In this locality the vesicle is in closest relation to the ureter."

The vesicles have a thick muscular wall, and are lined with cylindrical epithelium in the young which in later life becomes cuboidal.

The vesicles in addition to being seminal reservoirs have a secretory function and add one of the important constituents to the semen.

A complete understanding of the pathology and treatment of urethritis rests upon a knowledge of various points of dissimilarity between the anterior and posterior urethra. The following is a table of such points:

## ANTERIOR URETHRA.

Surrounded by erectile tissue (corpus spongiosum) for entire length, excepting for  $\frac{1}{2}$  inch in the roof of the bulb.

Many glands of Littre in roof and sides.

Ducts of Cowper's glands enter bulb.

"External urinary tract in free communication with the surface of the body and harbors all the microorganisms that may be thereon."

Fixed at only one end (triangular ligament) therefore can assume any curve (*e. g.*, on passing a sound) without causing pain to the patient.

Fluid may be introduced into anterior urethra and held there by compressing urethral meatus.

The introduction of a foreign body (*e. g.*, fluid or catheter) into the anterior urethra causes only pain or burning.

Inflammation causes simply pain.

There are no voluntary muscles surrounding the anterior urethra which can resist the introduction of a fluid or an instrument.

## POSTERIOR URETHRA.

No erectile tissue covering.

Very few glands of Littre.

Ducts of prostatic glands enter prostatic urethra.

Verumontanum with ducts of seminal glands in prostatic urethra.

"The lowest section of the aseptic internal urinary tract—entirely free from bacteria harbored by anterior urethra."

Fixed at one end by the triangular ligament and at the other by the prostate; so having a fixed "U" curve which when straightened (for example on introduction of a cystoscope) causes pain to the patient.

Fluid cannot be retained in posterior urethra. The compression of the surrounding muscles drives it either back into the bladder or forward into the anterior urethra.

The introduction of a foreign body (fluid or a catheter) into the posterior urethra causes pain plus a desire to urinate.

Inflammation causes pain plus frequency of urination.

By means of the perineal muscles the introduction of an instrument or fluids can be voluntarily resisted; therefore go gently as the sound or catheter approaches the posterior urethra.

## THE GONOCOCCUS.

**Microscopic Characteristics.**—**Source of Specimen.**—In a urethral gonorrhea a specimen for staining is most often obtained by pressing or "milking" the urethra, when a drop of pus is expressed. If there is no urethral drop, we may have to centrifugalize the urine which has just been passed and examine the sediment; or we may have to fish a shred from the urine with a pipette or platinum loop. The shreds most profitable to examine are those small ones which because of their richness in pus and paucity in mucus fall to the bottom of the glass of urine.

If the prostate and seminal vesicles are suspected of harboring the gonococcus, a drop of pus may be expressed from the urethra by massage of these. Sometimes after such massage the prostatic pus does not enter the anterior urethra, but instead is forced back into the bladder, whence it may be obtained for examination either from the patient's passed or catheterized urine.

**Preparation of Slide.**—If the glass slide is grease-free, heat is the only necessary method to fix the specimen. To remove the grease, wash the slide in soap and water before using, and then dry it.

**Spreading.**—The drop of pus to be examined may be spread upon the slide by dipping the edge of another slide in the pus and streaking

it along the first slide. Another good method is to wind the end of a tooth-pick tightly with cotton, dip this into the pus and gently streak the pus along the slide.

Urinary shreds are generally too thick to be examined; so they should either be flattened by pressing between two glass slides, or teased out with the end of a pipette.

**Fixing.**—Allow the preparation to dry in the air and then pass it several times through a Bunsen flame.

**Staining.**—*Methylene Blue.*—The smear is covered with a *saturated aqueous* solution of methylene blue for five seconds, then washed in running water, dried, and examined with the oil-immersion lens.

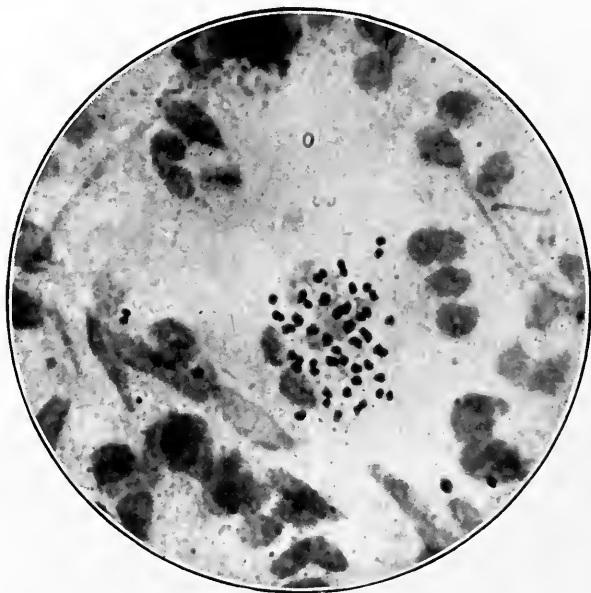


FIG. 163.—Photomicrograph of gonococci. (Ed.)

**Appearance of Gonococci.**—*Typical.*—The gonococcus of Neisser is morphologically a micrococcus which occurs in pairs (diplococci), separated by a fissure, each individual being kidney or coffee-bean shaped. This pairing (occasionally quadrupling) is in marked contrast to the irregular grape-like massing of staphylococci, and the wreath or chain-like arrangement of streptococci.

Gonococci have an affinity for the protoplasm of pus cells, and often completely fill the cell.

*Atypical.*—Gonococci may appear wholly between the pus cells arranged so as to resemble staphylococci or streptococci; or only one or two may appear in a pus cell.

**Value and Limitations of Methylene-blue Stain.**—*Acute Gonorrhea.*—For a common working diagnosis of *acute gonorrhea* the methylene-blue stain is the popular stain, and with it to supplement the clinical

evidence one cannot go far wrong. If the gonococci are typical as to arrangement and intracellularity, the only slip-up that can occur is through mistaking the gonococcus for that rare inhabitant of the urethra, the *Micrococcus catarrhalis*. And this mistake is not deadly, as the treatment for catarrhalis urethritis is much the same as that of gonorrheal urethritis. *If the cocci examined do not have a typical appearance, then a Gram stain should be made.*

*Chronic Gonorrhea.*—It is a different story in *chronic gonorrhea*. Both streptococci and staphylococci may be mistaken for gonococci. The Gram stain alone is of value.

*The methylene-blue stain should never be used to verify a cure of gonorrhea.*

*Gram Stain.*—The gonococcus, in addition to its other peculiarities, is what is called "Gram-negative," which means that in a slide which is treated by Gram stain and decolorized by alcohol the gonococci do not take, or are negative to the Gram stain; while other organisms to be differentiated from the gonococci are supposed to take or be positive to the Gram stain.

*Staining Slide.*—The smear on the slide is prepared as outlined above.

"The Gram stain is so frequently carried out in a loose and inaccurate manner that it seems worth while to note the method of staining employed at the Cornell laboratories. It is essential for the success of this stain that the various steps be measured by the watch. The film, after fixation by heat, is treated with an anilin water, gentian-violet solution for a period of three minutes, blotted, and a Lugol solution applied for two minutes. The film is again blotted and washed in absolute alcohol for thirty seconds. In the case of spreads made from exudates, differentiation in absolute alcohol is continued for a longer period, the time allowed depending upon the thickness of the film. As a counter-stain, a very weak watery solution of basic fuchsin is employed, which is allowed to act for thirty seconds. The anilin water, gentian-violet solution is made up according to the following formula: Anilin water, 3 parts; absolute alcohol, 7 parts; distilled water, 90 parts. This mixture is thoroughly shaken and filtered through a well-moistened filter. To the close filtrate add 2 grams of Grubler's powdered gentian violet, shake well, and set aside for twenty-four hours. For staining purposes, pipette off the supernatant fluid, which obviates the necessity of filtration. This solution will keep for from four to six weeks, and does not immediately deteriorate, as is popularly supposed. A watery solution of Bismarck brown gives a better counter-stain than the basic fuchsin, unless this is employed in very weak solution to avoid overstrain. Unfortunately, the brown has to be made up fresh. (Keys.)

As with the methylene-blue stain, the *Gram stain is not used to verify a cure of gonorrhea.*

**Method Employed for the Isolation of the Gonococcus.**—To establish the diagnosis of gonorrhea beyond all question of doubt the isolation and identification of the specific causative agent is essential.

Absolute certainty concerning this point is demanded only in certain cases of medicolegal importance (rape, divorce, etc.).

In acute cases the recovery of the gonococcus from the discharge, as a rule, presents no difficulties, providing suitable culture media are selected for this purpose. In chronic cases success depends upon the selection of the most favorable culture medium for the development of the gonococcus and upon adherence to certain details in securing the material for examination and preparing the cultivation. But even under the most favorable circumstances repeated examinations are frequently required before a definite opinion concerning the nature of the disease can be given.

The method given below has been followed in the bacteriological department of the Cornell Medical College for several years. A comparison of the results secured by means of cultural methods and by the complement-fixation tests in the same cases indicating the degree of reliability of the two methods is given under "Complement-fixation Test."

*Collection of Material for Examination.*—The patient is requested to appear at the laboratory with a full bladder. After wiping the urethral meatus and end of the penis with an aqueous solution of carbolic acid (1 to 60), followed by alcohol (50 per cent.), the patient is instructed to empty the bladder completely. The first portion passed is collected in large sterile test-tubes and is treated as indicated below. The main object of this step in the procedure is to mechanically sterilize the urethral canal. A sterile dressing is now applied to the end of the penis and after the lapse of thirty minutes the prostate and seminal vesicles are thoroughly massaged, the meatus is again sterilized and the urine passed is collected in a sterile test-tube of large size. Material from both samples of urine is now transferred to sterile centrifuge tubes and centrifugated at high speed for fifteen minutes. If the amount of sediment secured by these means is small, pour off the clear supernatant fluid, add more urine, and repeat centrifugation. The sediment thus obtained is employed for the preparation of films, which are stained with methylene blue in the usual manner. The number of bacteria found in the films determines the amount of material employed for cultural purposes. In addition three films from each sample are prepared and stained according to the Gram method.

**Cultural Methods.**—For the initial cultivation of the gonococcus, Wertheim's ascitic agar is employed. This consists of 2 parts of 2 per cent. agar prepared according to standard methods and 1 part of ascitic fluid. Since not all samples of ascitic fluid are equally suitable for this purpose it is necessary to test each new lot of fluid with different gonococcus strains with a view of determining this point.

Seven plates are poured in the usual manner. When solid, one set of three plates is stroked with sterile human-blood serum or defibrinated human blood which has been allowed to age for one week, with a view of destroying its normal bactericidal properties. Three ascitic agar plates are now stroked consecutively with the sediment without

recharging the spatula. The second set of plates previously stroked with human blood is similarly treated. Finally, one plate is inoculated with the human blood employed for enriching purposes to establish the sterility of this material.\*

After twenty-four, forty-eight and seventy-two hours' incubation the plates are examined and suspicious colonies consisting of Gram-negative cocci are transferred to ascitic agar tubes.

The colonies of the gonococcus are quite characteristic. For further identification the organisms recovered from the plates are grown on glucose and maltose agar free from meat-sugar and prepared in such a manner as to avoid cleavage of the maltose. The gonococcus ferments (with acid production) glucose only, which serves to distinguish it from other pathogenic Gram-negative cocci.

Serological methods, agglutination tests, and complement-fixation tests may, as a rule, be dispensed with.

NOTE.—The collection of material may be undertaken by the surgeon, in which case the urine must be kept at body temperature and immediately transported to the laboratory. Chilling of the samples reduces the chances of success. On the other hand, prolonged exposure to body temperature permits the growth of other contaminating organisms of normal inhabitants of the urethral canal which renders the isolation of the gonococcus more difficult.

**The Complement-fixation Test.**—Schwartz and McNeil<sup>10</sup> published their first article on the complement-fixation test in 1911. They say: "The chief point of departure from the methods of previous investigators in this line has been in the use of many different strains of gonococci in the preparation of the antigen, instead of only one. We were led to do this by the knowledge that different strains of the gonococcus seemed to differ considerably one from another, and the possibility suggested itself that perhaps the serum of a patient infected with one strain of the gonococcus might only fix complement in the presence of an antigen from the same strain, or from some closely allied strains, but might not do so in the presence of an antigen prepared from some widely separated strain. In case we proved this point we realized that the method would be too cumbersome for clinical application if all of the sera had to be tested against separate antigens prepared from a number of different strains of gonococci.

"The idea occurred to us that possibly an antigen prepared from a mixture of all the different strains might work satisfactorily; in other words, that a 'polyvalent' antigen might detect the presence of gonococcal antibodies every time that a single strain would do so."

(For the preparation of the antigen and serological methods consult their article.)

To Keyes<sup>5</sup> is due the first careful comparison between the relative merits of the complement-fixation test and a careful bacteriological test. In his series "complement-fixation test has been found wrong

\* These data have been very kindly supplied by Prof. Elser, of Cornell.

in 1 examination out of 47; bacteriological test, 1 in over 100 examinations."

**Cases Used In.**—McNeil<sup>8</sup> says: "In cases of anterior gonorrheal urethritis in the male, and acute vulvovaginitis in the female, a positive reaction is practically never obtained. But shortly after the posterior urethra in males, and the cervix and the glands of Bartholin in females are involved the same patient reacts positively."

The complement-fixation test is, therefore, sooner or later positive in cases (in the male) of posterior urethritis, prostatitis, seminal vesiculitis, epididymitis, cystitis, pyelonephritis, arthritis, etc.

**Time of Appearance.**—A positive reaction in the blood may not be looked for until the gonococci have persisted long enough to cause such a reaction; this usually takes about a month. "I have obtained a reaction in twelve days." (Keyes.)

**Time of Disappearance.**—"A positive reaction usually persists from six to eight weeks after a cure has been effected. It has also been found that antibodies disappear from the blood of rabbits immunized to gonococci in about the same period. Therefore, if a strong positive reaction is obtained seven or eight weeks after a probable cure, the patient should be treated as if he still harbored gonococci." (McNeil.) A negative reaction has been obtained two weeks after cure.

**Effect of Vaccines of Complement-fixation Test.**—If gonococcus vaccines are given to a patient who has a fading or weakly positive complement-fixation test, the vaccines will change this weakly positive to a strongly positive test.

If a patient has not recently had a gonorrhea, the giving of vaccines will affect his complement not at all.\*

It is possible that vaccines given to a patient whose complement-fixation test has *recently* become negative might change this negative into a positive complement-fixation test. If this be so, its medico-legal value is obvious.

Vaccines given to animals cause a complement-fixation test to persist for about fifty days. It is probable that this is a good index for the time of persistence in man.

**Weakly Positive Complement-fixation Tests.**—As far as my experience goes a complement-fixation test either weak or strong is caused alone by gonococcal inflammation.

A weakly positive complement-fixation test is interpreted as meaning that a gonorrhea is nearly or already cured. It should, however, be interpreted in relation to the clinical symptoms. If the clinical symptoms are at variance with the weakly positive test, then another complement-fixation test should be made after a period of some weeks or a culture should be the final test of cure.

I do not believe, however, that I have ever seen a weakly positive complement-fixation test become strongly positive (if vaccines are not given) or a weakly positive do anything else than become rapidly negative.

\* Schwartz is my authority for these two statements.

**Practical Value.**—In all cases of *anterior gonorrhea* a clear urine or a bacteriological test are necessary to declare a patient cured. In all cases of *posterior urethritis* I have, with very few exceptions, used the complement-fixation test alone. Its results, of course, must be interpreted with discretion. If a patient have a general arthritis, and a complement-fixation test pronounces this gonorrheal in origin, gonococci are not necessarily present in the urethra. In case of differential diagnosis between rheumatoid arthritis and gonorrheal arthritis the complement-fixation test fixes the diagnosis. Naturally, the complement-fixation is negative if an arthritis is due to a non-gonorrheal seminal vesiculitis.

Keyes has pointed out its value in solving certain medicolegal problems.

"A married man had acquired a gonorrhea several months previously and had infected his wife. No gonococci were found in the urine, and he was declared free from infection, although his urethritis was not cured. His wife was also examined and pronounced cured. No blood test was made upon either. Yet six months later he returned, denying extramarital exposure, but showing a fresh gonorrhea two weeks old. Both he and his wife immediately submitted to the complement-deviation test, and both were negative. Four weeks later he was positive and she negative, while she remained clinically clean. This development of a positive reaction in him showed his infection to be a fresh one due to extramarital exposure, in spite of his fervent denials."

The *accuracy of the complement-fixation test* varies according to the experience of the serologist in doing the test.

If a serologist has but recently taken up the test, his results should be checked up by comparison with the clinical and bacteriological findings. And even if performed by a serologist experienced in doing the test, a similar checking up should take place from time to time.

**Etiology of Gonorrheal Urethritis.**—This disease is practically always acquired by coitus on the part of the male with a woman infected with gonorrhea. One who treats gonorrhea should be acquainted with various peculiarities in its transmission, because the afflicted male always wishes to place the blame for his disease; wishes to know why he has acquired it; and why another male friend, possibly the husband, is free from it.

Wertheim says husband and wife may become so immune to each other's gonococci that it is impossible to have a further exacerbation of the disease between these two. When a third person trespasses, however, he may acquire an acute gonorrhea, while neither of the original pair have any manifestations of the disease.

The male may have used a protector (condom). "Such a gonorrhea is acquired during preliminary skirmishing."

One of two men who have connection with the same woman may acquire gonorrhea and the other not. Difference in the conformation

of the urethral meatus may have caused this; a wide meatus predisposes. Also one may have been intoxicated, which also favors the acquisition. It is well to remember that a medical certificate alleging freedom of the woman from gonorrhea means nothing. Such certificates are generally given by physicians who are incompetent and untrustworthy. Such a certificate may antedate the present gonorrhea. It is probable that the female is infectious at times and at other times uninfected; for example, the local congestion due to menstruation may bring forth the hidden gonococcus.

**Pathology of Acute Gonorrheal Urethritis.**—*Acute Anterior Gonorrhea.*—Our knowledge of this dates to the work of Finger, Gohm, and Schlagenhauser<sup>2</sup> who inoculated criminals condemned to death and then found by an immediate postmortem the changes caused by the gonococcus. Keyes sums up their work as follows:

“Thirty-eight hours after inoculation the gonococci had only just begun to effect an entrance between the epithelial cells. The lacunæ of Morgagni were crowded with the cocci; diapedesis had begun and intracellular gonococci were found among the few leukocytes on the surface of the epithelium. At the end of three days the inflammatory process was well under way. The surface of the mucous membrane was covered with pus, its epithelium infiltrated by bacteria from one side and by leukocytes from the other. The inflammation showed four striking characteristics, viz.: (1) The pavement-epithelium of the fossa navicularis, although swollen with leukocytes, resisted the invasion of the gonococci almost absolutely; (2) the cylindrical epithelium of the penile urethra was generally invaded; (3) this invasion was most marked about the crypts and glands, which were packed with pus and gonococci; (4) the subepithelial connective tissue, though showing every evidence of inflammation, contained few gonococci except in the neighborhood of the crypts and glands.”

The inflammation extends until gonococci have penetrated deep into the layers of the mucous membrane, which has become acutely congested, the epithelium undergoing mucous degeneration and exfoliating in patches. Later the mucosa is occupied by embryonic cells, becomes thick, inelastic, and bleeds easily. The inflammation may extend beyond the mucosa to the submucous layer and even to the corpora cavernosa. This may be accompanied by phlebitis, arteritis, or lymphangitis.

The ducts of many of the urethral glands and crypts are inflamed. The inflammation in the ducts may simply resolve or the inflammation may cause closure of the orifices of the ducts and extend into the glands, which may be converted into pus sacs. Such an abscess cavity may discharge through the gland duct into the urethra or rupture directly through the mucous membrane; or the gland may enlarge and finally rupture externally through the corpus spongiosum.

In most cases, if the patient be properly treated, or at least let alone, the inflammation travels slowly toward the posterior part of the anterior urethra, the gonococcus diminishing in virulence the while. The

inflammation may be restricted to the anterior urethra and never reach the posterior.

*Acute Posterior Gonorrhea.*—In most cases, however, the gonorrhea does reach the posterior urethra, sometimes stormily, sometimes quietly. These stormy invasions are generally the result of improper and too early instrumentation or indiscretions on the part of the patient; rarely to a virulent infection.

By the time the gonococci reach the posterior urethra their virulence is generally diminished and the body has been manufacturing antibodies for some days. So the posterior urethra may be acutely inflamed, or attacked by somewhat enfeebled gonococci, which results in a more or less subacute inflammation.

Almost every posterior urethritis involves both the membranous and prostatic urethra. The glands of the membranous urethra are few and inflammation of this portion is always overshadowed by the prostatic involvement. The verumontanum may be acutely inflamed and the inflammation may travel to the seminal vesicles or by way of the seminal ducts to the epididymis. Acute epididymitis is commoner than acute seminal vesiculitis.

**Pathology of Acute Gonorrheal Prostatitis.**—Acute prostatitis is of three different grades.

1. *Catarrhal prostatitis* probably occurs in all cases of posterior gonorrhea; the gonococcus enters the prostatic ducts and causes a proliferation and desquamation of epithelium and leukocytes. This may resolve or become chronic.

2. *Follicular prostatitis* is more infrequent than catarrhal. The gonococcus enters a prostatic duct and causes a purulent inflammation. The walls swell and the mouth of the duct is blocked with pus; a small abscess forms which breaks through the duct or through the surface of the gland.

3. *Parenchymatous Prostatitis.*—All parts of the prostate are affected; the glands may be primarily so, and the fibromuscular stroma secondarily involved.

There is marked congestion and serous infiltration; then small rounded infiltration with enlargement of the gland. This form may resolve completely, but it often goes on to chronic induration and leaves an enlarged prostate. The most severe form is purulent inflammation with abscess formation, when a half or all of the prostate may become a pus sac. This may break into the urethra, or into the rectum, or appear in the perineum, or ischiorectal fossa. A periprostatic abscess may follow a prostatic abscess. We may have finally periprostatic phlebitis, which may cause thrombosis and metastatic abscesses.

Urinary infiltration with gangrene of the perineum and gangrene of the penis, because of compression and thrombosis of the "plexus pubes impar," may occur.

**Pathology of Cowperitis.**—Acute inflammation of Cowper's glands follows the same grades of inflammation as are seen in the prostate.

If an abscess of Cowper's glands forms, it generally points in the perineum on either side of the bulb.

**Pathology of Chronic Gonorrheal Urethritis.**—The acute inflammation generally passes over into the subacute and chronic forms within a few weeks. The discharge and gonococci diminish. The embryonic infiltrations are resorbed and the epithelium is gradually regenerated, but probably in no case are the cylindrical epithelial cells restored as such. In their place is put down pavement-epithelium. Gonococci do not attack pavement-epithelium as readily as they do cylindrical, which accounts for the severity of the first gonorrhea and comparative mildness of future attacks. Aside from the above the urethra may return to normal. With subsequent inflammations or with a severe and long first gonorrhea, this pavement-epithelium may be replaced by flat squamous epithelium which still further resists the entrance of the gonococcus.

Gonorrhea becomes chronic because the inflammation persists in glands and crypts of the urethra. The glands of Littre may become small pus sacs because of occluded ducts; these sacs may rupture and the gland become obliterated, filled with scar tissue; or they may be converted into cysts. The crypts may become reddened. The mucosa because of the chronic inflammation may lose its grayish-yellow color and its striæ and become red. (Soft infiltration of Oberlander.)

With the progress of the inflammation this redness may change to a grayish color because sclerosis of the bloodvessels and that part of the urethra become a more or less rigid tube. In places the caliber of the tube may be encroached upon. There may be papillary growths and granulating areas. This is the *hard infiltration of Oberlander*, which is the beginning of stricture formation and is most often seen in the anterior urethra. Stricture of the posterior urethra is relatively rare.

**Pathology of Chronic Prostatitis.**—Chronic prostatitis may follow an acute prostatitis but it usually begins insidiously, and gives rise to but few symptoms in its early stage. Most cases are gonorrheal or postgonorrheal in origin. Masturbation and sexual excesses are factors in its cause. Cystitis and even pyelonephritis sometimes are accompanied by a prostatitis.

Various bacteria are found in the prostatic secretion, from the gonococcus and streptococci, staphylococci, and colon bacilli.

The glands of the prostate show proliferation and desquamation of epithelium, and their lumen occluded by pus and epithelium. Later there is periglandular round-celled infiltration. Sclerosis and contraction of the new tissue takes place and causes destruction of glandular tissue or dilatation from obstruction of the gland ducts. The gland may therefore feel small and firm or, more often, enlarged with soft, "mushy" spots. Sometimes there are small points of suppuration throughout the prostate.

**Pathology of the Seminal Vesicles.**—Belfield was the first to get radiographs of both normal and diseased seminal vesicles. Through a

cut in the vas he filled the vesicle with collargol and then took radiographs. Cabot, Barney and others have done likewise. It is difficult to say what percentage of posterior gonorrheas affect the seminal vesicles. Caulk\* says "That 90 per cent. of gonorrheas became posterior and that 90 per cent. of these cause involvement of the seminal vesicles." If the seminal vesicles are involved by the gonorrheal inflammation, then the processes may be acute, subacute or chronic. Because of the convoluted tubules of the vesicle and the small urethral exit, cure of the condition is often very difficult. In acute infections, which are almost invariably caused by the gonococcus, we may have obstruction of the ducts, abscess formation, perivesicular infiltration, etc. This inflammation may result in the pus emptying through the main duct into the urethra or it may become subacute or chronic; or the pus sac may rupture into the ischiorectal fossa, rectum, or peritoneal cavity. The gross pathology of chronic inflammatory lesions of the seminal vesicles is quite variable. They may be large, firm, and distended with obstructed ducts and abscess formation. There is apt to be a perivesicular infiltration, so that one may not be able to outline the confines of the vesicle because of their being matted down with a plastic exudate. In fact, operative experience in acute seminal vesiculitis, in which the rectal touch has seemingly demonstrated swollen vesicles and supposed abscesses, has shown that the vesicles in such cases are not distended with pus but the process is usually one of perivesicular infiltration. In the chronic process gonococci are rarely found. Staphylococci, streptococci, colon and tubercle bacilli, and various other unclassified bacilli have been isolated. Not infrequently sterile cultures are obtained from the seminal fluid. Cabot and Barney found that the perivesical adhesions were most frequent at the lower end of the vesicle and the vas, and that if one vesicle is involved, its fellow "may be safely accused." Caulk says that "the seminal vesicle bears an important pathological significance also on account of its proximity to the ureter. Young, Squier, and Voelcker have reported cases of renal infection due to ureteral stricture secondary to the vesicular infiltration."

**Symptoms of Acute Anterior Gonorrheal Urethritis.**—*Incubation.*—The limits of this period are two and twelve days; oftener five to seven days. (Experimental inoculation produces a discharge on the second, third, fourth and fifth days.) A non-gonorrheal urethritis occurring in a damaged urethra and caused by sexual strain, excessive alcohol, etc., often has a very short incubation, say twenty-four hours. So also an acute exacerbation of a chronic gonorrhea. A long foreskin may mask the discharge for some days.

*Invasion.*—If a patient is intelligent, he generally notices the early symptoms of gonorrhea, itching, tickling, or burning in the meatus. If unintelligent, he often delays his visit to the physician until the tickling has become (on the second or third day) a vigorous burning

\* Caulk<sup>1</sup> has written a very complete review of the "Surgery of the Seminal Vesicles, and their Ducts." I have closely followed and quoted from this review.

on urination along the course of the anterior urethra and a urethral discharge has become established. Or the patient's attention may have been attracted by the red and swollen meatus which accompanies the discharge. The inflammation may reach its height very early (in a few hours), or late (a number of days). The factors which modify the attack are the vigor of the strain of gonococcus with which the patient is affected; the natural or acquired immunity of the patient (acquired by previous attacks of gonorrhea), the age of the patient (boys and old men are prone to severe attacks), and the treatment.

*Local Symptoms.*—When the attack has reached its height, there are four cardinal local symptoms: *discharge, burning on urination, red meatus, and painful erections.*

The *discharge* is formed of the products of the inflammation, pus, epithelial cells and gonococci. It is at first mucoid, then rapidly changes to typical thick, yellowish pus. Later it loses its yellow color and again becomes mucoid. The discharge varies in quantity according to the severity of the inflammation and the period of time between urinations. When the patient urinates, the urethra is washed fairly free of pus. The discharge is usually greatest in the morning because of the long interval without urination. It may be tinged with blood.

*Burning on Urination.*—The acid urine passing over the inflamed urethra causes pain. This pain is an index of the acuteness of the attack, and may be very severe or inconsequential.

The *red and swollen meatus* is the index of the condition of the anterior urethra in acute gonorrhea. It is the main differential point between a new infection and an exacerbation of an old gonorrhea. In the latter the infection comes from the posterior urethra, and when it reaches the anterior it is in a subacute stage, which accounts for the absence of an inflamed meatus. Reinfections run a much milder course than new infections, and naturally are liable to be more chronic.

*Painful erections* are due to the stretching of a rigid and inflamed urethra. Normally the urethra is elastic and easily distensible. The inflamed urethra may be so rigid and fixed that when the corpora cavernosa distend on erection the penis, as a whole, may curve downward. This is known as *chordee*, and often causes excruciating pain and perhaps bleeding.

*Variations in Attacks.*—The above describes a typical attack. There may be all grades of infection, from an attack in which the one symptom is urethral discharge, which contains gonococci, to a hyperacute attack which rapidly invades the posterior urethra.

*General symptoms* are often present in a mild degree. Lassitude, slight temperature, loss of appetite, and possibly chills may accompany the attack.

*Urine Changes.*—Urine running from the bladder reservoir over a urethra covered with pus washes off that pus so that when the urine is passed it contains pus cells in suspension. This causes the urine to become more or less cloudy; or if there is no free pus but only shreds of pus in the urethra, the urine is clear, with the shreds floating

in it. Because of these facts, and because the urethra is divided into an anterior and posterior part, various tests have been suggested to determine by the examination of the urine the source of the pus and shreds.

The two tests most in use are Thompson's\* two-glass test and Kollman's five-glass test.

Using the two-glass test the first glass is cloudy while the second is clear, although the first two may be cloudy if the discharge is very profuse.

**Diagnosis.**—The diagnosis is principally between non-gonorrheal urethritis (p. 334) and an acute exacerbation of an old gonorrhea. In the latter the short incubation, the lack of a red meatus, the history, and the presence of a posterior urethritis (pus in the prostate) generally clinch the diagnosis.

**Course.**—An acute anterior urethritis may resolve or become a chronic anterior urethritis. More likely it is complicated by an acute or subacute posterior urethritis.

**Complications of Acute Anterior Gonorrhea.**—These are abscess of the urethral glands, peri-urethritis and peri-urethral abscess, balanoposthitis, lymphangitis and adenitis, and inflammation of the erectile tissue.

**Abscess of Urethral Glands, Peri-urethritis and Peri-urethral Abscess.**—Any of the urethral glands may be invaded by the gonococcus, the duct of the glands plugged by the inflammation and the gland suppurate.

\* The most popular, the simplest and perhaps the least accurate is the two-glass test of Thompson, viz.: the bladder is full of urine. The patient passes four ounces of urine into a first glass and the remainder into a second glass. We may then have one of four conditions:

- I. First glass cloudy, second glass clear.
- II. First and second cloudy.
- III. First glass clear, second cloudy.
- IV. Urine clear but shreds in first or second, or both.

(It is supposed that the cloud is due to pus. This can definitely be determined by the microscope. If the cloud is due to phosphates, acetic acid dropped into the urine will clear it. If the cloud is due to internally administered copaiba, acetic acid will not clear the urine.) *In acute gonorrhea*, I means an anterior urethritis and no inflammation above the cut-off muscle. *In chronic gonorrhea*, I may mean an anterior and posterior urethritis. It never means bladder or kidney pus. II generally means an anterior and posterior urethritis. It may mean only an anterior urethritis with such a profuse discharge of pus that the first four-ounce wash of urine is not enough to cleanse the urethra of pus. It may mean bladder or kidney pus. III means a posterior urethritis. The prostate laden with pus has squeezed this pus into the urethra with the final bladder squeeze occurring at the end of urination. IV may mean a mild anterior or posterior urethritis or both. *The two-glass test must be interpreted in conjunction with the symptoms. If there is a conflict between the two, a further test, the Kollman, must be made. Kollman Test Modified:* The anterior urethra is washed (using sterile water) with a syringe or through a small rubber catheter passed as far as the bulb. The washings are continued until the return irrigation is clear. The patient then passes urine into a second glass (four ounces). This represents posterior urethral pus or shreds. The prostate is then massaged and urine is passed into a third glass, which represents the prostatic contents. The fourth glass of passed urine represents pus coming from above the prostate (bladder or kidneys). I confess that I rarely now use this test. I also confess to treating as a chronic urethritis a case of tuberculosis of the kidney for some weeks before I suspected something wrong and did a cystoscopy. At present if in doubt I always put a catheter into the bladder and carefully observe the washings. If the first four or five washings (two ounces each) are cloudy or persist in their shreddy contents, I then cystoscope or urethroscope the patient.

According to the length of the duct and the acuteness of the inflammation the abscess discharges its contents directly into the urethra or through its duct and so heals. The abscess often gives localized pain, and if the urethra is palpated, can be felt as a small shot-like mass along the urethra. Not infrequently these abscesses are multiple and can be felt along the entire pendulous urethra. Such cases are often very acute and run a long course. Cases in which there is a suddenly increased urethral discharge with perhaps reinfection of the urethra are generally due to the rupture of a urethral abscess.

Often the abscess does not rupture into the urethra but involves the peri-urethral tissues and points externally. A favorite place for such an abscess is just back of the frenum. Occasionally an abscess can be incised intra-urethrally through an endoscope. Generally, however, there is a distinct space corresponding to the duct of the gland between the abscess and the urethra. Then the abscess points externally and is opened through a small incision. Healing is generally rapid. In certain cases, however, a urethral fistula is left which requires operation to close.

*Balanoposthitis.*—This usually occurs because of a tight foreskin which retains the gonorrheal pus. Sometimes the patient retracts the foreskin back of the corona but cannot get it back. The resulting paraphimosis can often be reduced. If not, a dorsal incision has to be made.

*Lymphangitis and Adenitis.*—This is seen fairly often. The inflamed lymph channels can be felt as hard, tender cords extending along the dorsum of the penis. Sometimes an enlarged gland is also felt. Under appropriate treatment this readily subsides. I have never seen one suppurate.

*Inguinal adenitis* and suppuration of the inguinal glands are not rare.

"*Inflammation of the erectile tissue, spongeitis, and cavernitis*" are extremely rare complications of gonorrhea, if we except that type of the former that manifests itself in chordee." (Keyes.)

**Symptoms of Acute Posterior Gonorrheal Urethritis.**—The membranous and prostatic urethra, and the prostate are always attacked in posterior urethral gonorrhea. In most cases it is probable that the seminal vesicles are also attacked. Whether or not posterior urethritis is classed as a complication of urethral gonorrhea, it is a fact that in the majority of cases of gonorrhea the posterior urethra is invaded by the gonococcus. As the posterior urethra is intimately associated with the function of urination, acute inflammation of the posterior urethra is accompanied by disturbances of urination.

The patient gives a history of a preceding anterior urethritis, or if the acute posterior urethritis is an exacerbation of an old posterior gonorrhea, then the history of this.

*Frequency of Urination.*—The patient generally has increased frequency, particularly at night. He may arise once at night, or in a severe attack he may urinate as often as every fifteen minutes, day and

night; he may have increased pain on urination; or pain particularly at the end of urination, caused by the closing down of the sphincter on the inflamed prostatic urethra; this pain may be in the perineum, hypogastrium, in the rectum, at the end of the penis or along the urethra. For the same reason he may possibly have a terminal hematuria.

*Urinary Changes.*—Using the two-glass test the second urine is cloudy.

*Course.*—Acute posterior gonorrhea remains at its height from a number of days to a week, and then all the symptoms may gradually subside until the patient is left with a slight urethral discharge, generally in the form of a "morning drop" (chronic gonorrhea), or one of a number of complications may set in.

*Complications of Acute Posterior Gonorrhea.*—These are cowperitis, prostatic abscess, seminal vesiculitis, epididymitis, (see p. 300), cystitis, (see p. 301), pyelonephritis, peritonitis.

*Cowperitis.*—We generally say that an abscess originating on either side of the membranous urethra is due to an abscess of Cowper's glands. Such an abscess is rarely diagnosed when small, probably because of the infrequency with which we try to palpate Cowper's glands. Generally, when a diffuse abscess appears on one or both sides of the bulb (if stricture, prostatic abscess, and ischiorectal abscess can be excluded), we attribute such an abscess to a cowperitis. The deep layer of the perineal fascia prevents an abscess originating in Cowper's glands from traveling backward, which accounts for its appearance in the perineum. Luys reports two cases in which a more or less chronic cowperitis was diagnosed by palpating the enlarged Cowper's glands and expressing (intra-urethrally) the pus therefrom.

The cure consisted in massage of the glands and irrigation and dilatation of the urethra. Generally, however, the abscess points externally and either ruptures or is incised.

*Prostatic Abscess.*—The division line between acute prostatitis and prostatic abscess is hard to draw. A patient may have only the symptoms of a posterior urethritis and yet may have a small superficial prostatic abscess which makes itself known by rupturing into the urethra and relief in the patient's symptoms. As a rule, however, a prostatic abscess of any magnitude involving a part of one or both lobes of the prostate gives the following symptoms:

1. It occurs in the course of an acute or subacute gonorrhea.
2. The symptoms of the preceding posterior urethritis, dysuria, pain and frequency become worse. If there be only an antecedent acute anterior urethritis and the prostatic abscess is the result of an overwhelming infection, the dysuria, pain, and frequency begin intensely. The pain of the acute prostatitis, referred generally to the region of the prostate, is surprisingly acute and tenacious. I remember one patient with an acute parenchymatous prostatitis who had, for nearly two weeks, an intensely acute pain "like a hot coal" in his prostate. He could not sit down—particularly on a cushion; hard surfaces seemed

best adapted for sitting—and his pain was only controlled by the generous use of morphin.

3. Acute retention of urine, partial or complete, is often present. If an acute retention occurs during an acute gonorrhea, it is nearly always caused by a prostatic abscess. The retention may be the only symptom.

4. The general symptoms may be those of any acute infection, chill, vomiting, fever, etc.

*Physical Signs.*—The prostate (by rectal examination) is enlarged as a whole or in part. It may be very tense and hard, or if the abscess is formed, soft and fluctuating. The gentlest palpation may cause one of the abscesses to rupture.

*Course.*—If only miliary abscesses are present, these may resolve without any appreciable increase in the discharge of pus. An abscess may form which may rupture into the urethra or rectum; or it may point in the ischio-rectal fossa or in the corpora cavernosa or in the scrotum. A prostatic abscess rarely ruptures in the portion of the prostate anterior to the urethra. Periprostatic abscesses often complicate matters.

Thrombosis and metastatic abscess are fairly rare.

*Acute seminal vesiculitis* is always associated with posterior urethritis, the symptoms of which often mask the symptoms of the former. It is hard to tell, however, how often a posterior urethritis is complicated by a seminal vesiculitis. The finger passed into the rectum reveals an enlarged, tense, seminal vesicle above the prostate.

The inflammation may resolve and the seminal vesicle may discharge its pus into the urethra, or more rarely it may rupture into the ischio-rectal fossa, rectum, or peritoneal cavity, or the condition may become chronic.

**Symptoms of Chronic Anterior Urethral Gonorrhea.**—It is hard to say exactly when a gonorrhea ceases to be acute and becomes chronic. When the acute symptoms, the burning on urination, and the frequency of urination cease and examination shows that gonococci are still present, then the case goes into the chronic list. Many an acute case never becomes chronic. Every chronic case is potentially acute, and as long as the gonococci are present in the urethra or its glands acute flare-ups may occur.

*Cause.*—The reason that gonorrhea becomes chronic involves the many questions of a patient's resistance, previous damage to the urethra, malformations of the urethra, improper treatment, virulence of the gonococci, etc. Because of these many factors it is impossible to make more than a poor guess as to what cases will become chronic. If accurate bacteriological tests are made, it will be found that in most chronic cases the gonococcus is associated with other organisms. What effect these have in causing the gonorrhea to persist is unknown. Apparently the other organisms are fairly innocuous, and it is the gonococcus that does damage.

While the symptoms of a chronic anterior and posterior urethral

gonorrhea are much the same; while the site of the inflammation is only revealed by the physical examination; and while the one often exists in conjunction with the other, it is nevertheless a fact that if we determine which focus is the principal one the eradication of this focus will often cure the gonorrhea in the secondary focus.

For example, if we find that chronic anterior and posterior gonorrhea exists and that the prostate is full of pus, proper treatment of the prostate will cure the gonorrhea. If there are cysts or granulations in the anterior urethra, then eradicating these will generally cure the gonorrhea in both anterior and posterior urethra.

*Urethral Discharge.*—It is this discharge which generally brings the patient to the physician. The discharge may be pussy, mucoid, or watery; yellow, white, or colorless. The discharge shows under the microscope pus cells and epithelia, either predominating; gonococci are found either intracellularly or extracellularly.

*Pain*, if present, is generally an itching or mere tickling referred to the end of the penis or urethroscrotal angle or indefinitely along the urethra.

*Physical Examination.—Urine.*—There are shreds\* or pus only in the first passed glass of urine.

*Palpation.*—Enlarged glands may be felt along the urethra. If a sound is introduced into the urethra, the glands can be more easily felt.

*Instrumentation.*—A silk or metal bulbous bougie as large as the meatus will admit is introduced and roughenings, granular places that easily bleed or distinct strictures are sought.

The meatus should be at least 24 F. to make such an examination efficient. If it is not as large as this, a meatotomy to 26 or 28 F. should be first performed.

*Urethroscopy.*—The more often urethroscopy is done in intractable cases, the more often is the cause of the persistence of a stubborn gonorrhea found. An open tube urethroscope with or without water dilatation or a urethroscope with a lens system with water dilatation may be used. For purposes of diagnosis I personally prefer the latter.

*Pathological changes* caused by the gonococcus and seen with the urethroscope are (1) chronic diffuse inflammation; (2) inflammation around ducts of urethral glands; cysts of the urethral glands; (3) granulations or polypi; (4) phosphatic incrustations on an inflamed or ulcerated base.

*Indications for Urethroscopy.*—It should be done in all cases of persistent gonorrhea. The one absolute contra-indication is acute inflammation of the urethra.

\* Keyes emphasizes the fact that: (1) "Shreds are no index of gonorrhea. They are currently found in the urine passed by men who have never had gonorrhea. (2) The shape and size of shreds does not indicate what part of the urethra they come from. (3) Shreds mean chronic, localized inflammation of the urethra. (4) Shreds heavy with pus sink rapidly in the urine. They indicate active inflammation or ulcer or stricture. (5) Lighter shreds often testify to an inflammation so mild that it presents no danger and is entirely uninfluenced by treatment. Shreds call for treatment by dilatation (unless this irritates)."

**Diagnosis.**—I do not believe that from the symptoms or physical signs a gonorrheal urethritis can be differentiated from a non-gonorrheal urethritis. Either may be acute or chronic; either may be of short or long duration; the final test is to find the gonococcus either in a smear or by a culture.

Such conditions as tuberculosis of the urethra, leukoplakia, and other rare conditions may give all the symptoms of a non-gonorrheal urethritis. They will be revealed by the urethroscope.

Other conditions from which an anterior urethritis must be diagnosed are infections above the triangular ligament. These can be accurately diagnosed by the five-glass test, by the urethroscope, and by the cystoscope.

**Evidence of Cure.—Clinical.**—If the urine from the urethra is pus-free, that urethra is gonococci-free. This means pus-free as regards any shreds in the urine and pus-free after massage of the anterior urethral glands, and dilatation of the anterior urethra. If the patient has pus in the anterior urethra in which gonococci cannot be found, a silver nitrate solution (1 or 2 per cent.) or a sound may be used to stir up any latent gonorrhea. I now never use this method. It may stir up a somewhat intractable urethritis. Cultural methods are more accurate.

**Complement-fixation Test** (p. 296).—A positive reaction in anterior urethritis, no matter how acute or how chronic, is never obtained. A similar condition of affairs is found in acute vulvovaginitis in the adult female.

**Culture.**—If the anterior urethritis is not pus-free, a culture has to be relied upon (see p. 295).

**Complications of Chronic Anterior Gonorrhea.**—The one important complication is stricture of the urethra (p. 384, Chap. XI).

**Symptoms of Chronic Posterior Urethral Gonorrhea.**—Chronic posterior urethritis is chronic prostatitis either alone or combined with a chronic inflammation of the seminal vesicles or chronic inflammation of the verumontanum.

**Etiology.**—It is the gonococcus we always seek, and here in the prostate it loves to stick. Two factors in the etiology are important:

1. In prostatitis originally caused by the gonococcus, if the prostatitis persists and if no new gonococcal infection occurs, the gonococcus is gradually replaced by other organisms, so that at the end of the fourth year (this is the long limit) all cases are gonococci-free. (These are statistics from the *Lehrbuch der Urologie*.) Keyes, less conservative and probably more accurate, says: "I believe that the gonococcus does not persist in the male urethra for more than three years; while in at least 90 per cent. of cases it disappears, with or without treatment, within the year."

2. Not all cases of prostatitis are gonorrheal in origin. In 358 cases, Young, Geraghty, and Stevens found that a previous history of gonorrhea was present in but 73.2 per cent. The remaining cases gave histories of masturbation (which is a good general history of all genito-

urinary cases) or prolonged sexual excitement, traumatism, instrumentation, infectious diseases. In 14 per cent. no etiology was obtained.

*Urethral Discharge.*—A chronic urethral discharge is often the sole symptom of a prostatitis. Such a discharge may be caused by the prostatic secretion running into the anterior urethra or by an accompanying anterior urethritis.

*Disturbances of Urination.*—The day and night frequency of the acute prostatitis may persist and be a feature of the chronic form. There may be urgency, pain on urination, or terminal pain—typical irritable prostatitis. There may be obstruction to urination caused by contracture of the bladder neck; the obstruction causing partial or complete retention. Our attention then turns from a less important prostatitis to the graver contracture.

*Pain.*—As abnormalities of the verumontanum are being more studied, we are coming to believe that many of the pains formerly attributed to a diseased prostate are due to some pathological condition of the verumontanum. As the two often occur together it is hard to differentiate the symptoms caused by either. A diseased prostate perhaps plus a diseased verumontanum may give a feeling of fulness or pain or burning in the prostate itself. This is often relieved after emptying a prostate of its contents by massage. Pain in the urethra either referred to the penoscrotal angle or to the end of the penis is probably more often due to disease of the verumontanum. Perineal pain is often present or the pain may be referred to the testicles or cord.

Because of the varied sites of the prostatic pain, confusion in the diagnosis often arises, and an appendicitis, ureteral or bladder stone and many other conditions have been confused with a simple prostatitis.

*Disturbances in the Sexual Function.*—These are probably more due to disease of the verumontanum than to prostatitis. They comprise all the symptoms usually classed under sexual neurosis, viz., premature or delayed ejaculation, too frequent seminal emissions, poor or painful erections and the like.

*Exacerbations.*—Those patients who have frequent flare-ups (not reinfections) due to sexual, alcoholic, or instrumental excesses generally have a focus in the prostate. These attacks are commonly and fairly accurately designated by the patients as strains.

*Physical Examination.*—*Pus in the Urine.*—The modified method of Kollman may be used, but the more practical office method is to have the patient empty his bladder, then massage the prostate and examine the drop that generally appears at the meatus. If it contains pus cells, then the prostate is the offending member. Sometimes a drop does not appear at the meatus; instead the pus is forced back into the bladder. If so, have the patient pass the few cubic centimeters of urine that have collected in his bladder. This is examined under the microscope.

*Palpation.*—An enlarged boggy prostate which pits on pressure, or a lumpy and hard prostate, may be felt; or one may feel an entirely normal prostate from which a drop of pus may be expressed. If a

stained specimen is carefully examined, gonococci will usually be found, but this examination is not to be depended upon. A complement-fixation test or a culture is the only safe test.

**Warning.**—An acute epididymitis is not infrequently caused by the too frequent or too harsh massage of the diseased prostate. Gentleness first!

**Instrumental.**—A bulbous bougie as large as will pass the meatus (24 F. at least) is introduced into the posterior urethra as far as the vesical sphincter. This is withdrawn and any roughenings, narrowings, or undue bleeding on the withdrawal of the bougie are noted.

Contracture of the bladder neck cannot be diagnosed in this way (see Vol. II).

**Urethroscopy.**—By using the modern irrigating urethrosopes we more often find a reason for the deadly persistence of the gonococcus in the posterior urethra. Urethroscopy tells us nothing of what is happening in the interior of the prostate, but is used to reveal pathological processes of the posterior urethra, and particularly of the verumontanum.

**Pathological Lesions Seen by Urethroscopy:** (1) Enlarged and boggy verumontanum; (2) cysts of the verumontanum or posterior urethra; (3) granulations or papilloma of the verumontanum or posterior urethra; (4) inflammation around the ejaculatory ducts; (5) diverticula, natural or acquired (postoperative), of the posterior urethra; (6) incrustations on an inflamed or ulcerated base.

**Indications for Urethroscopy.**—These vary with the type of the instrument used. I believe more and more that urethroscopy is worthless with the non-irrigating instruments. It should be performed in all stubborn cases of chronic prostatitis. This indication has naturally a wide latitude and what would be an indication for one urologist would not be such for another. *Urethroscopy should always be the last of all examinations.*

**Contra-indications.**—All acute inflammations of the urethra.

**Urethroscopy to Confirm Cure.**—Much has been written particularly by the German urologists about never discharging a case as cured without complete urethroscopy. I believe, however, that urethroscopy does not tell *when* a patient is cured but *why* a patient is *not* cured.

**Course of Chronic Prostatitis.**—Cases may be very stubborn; they may relapse so often that a cure seems impossible. Opposed to this is the extreme mildness of others which immediately respond to appropriate treatment. In no case can a physician, with any degree of accuracy, predict the course; all that he can do is to intelligently follow the course.

**Complement-fixation Test.**—This is positive when a posterior gonorrhea has been present for a month or more. Occasionally if the posterior urethritis is very acute, it appears earlier (see p. 297 *et seq.*).

**Diagnosis.**—The differential diagnosis is between gonorrheal prostatitis and (1) non-gonorrheal prostatitis; (2) seminal vesiculitis; (3) inflammation of the verumontanum; (4) papillomata, granulations, ulcerations, and rarer conditions, as tuberculosis, leukoplakia of the

posterior urethra; (5) inflammation of the urinary tract above the prostate.

1. *Non-gonorrheal Prostatitis*.—A prostatitis troubles a patient not especially because of its symptoms but because he believes it an uncured gonorrhea. Most cases of prostatitis are in fact gonorrheal in origin, therefore a smear of the prostatic secretion, or a culture, or a complement-fixation test for gonorrhea is made to determine if gonococci are still causing the trouble. Whether the prostatitis is gonorrheal or not, the patient is now put on an appropriate course of treatment. If treatment of two or three weeks fails to produce any effect, then urethros-copy or cystoscopy should be performed.

2. *Seminal vesiculitis* is always accompanied by prostatitis. Which is the principal infection is determined partially by palpation and partially by first massaging the prostate and examining the secretion and then massaging the seminal vesicles and examining their secretion.

3. *Inflammation of the Verumontanum*.—This, like the above, is probably always accompanied by prostatitis, and it is probable that the treatment used to cure the prostatitis in most cases cures the inflammation of the verumontanum. The differentiation is made by examining the prostatic secretion microscopically and the verumontanum through the urethroscope.

4. Cysts, papillomata, granulations, ulcerations, and rarer conditions, as tuberculosis and leukoplakia, can be differentiated with the urethroscope alone. The first four are frequently caused by gonorrhea; they are particularly prone to be about or on the verumontanum; and when present keep up inflammation.

5. Inflammation of the urinary tract above the prostate. In these cases a complete cystoscopy is often necessary to make the diagnosis.

**Evidence of Cure.**—*Clinical*.—Practically all urologists believe that a pus-free urine means a urethra free from gonococci.

But most urologists insist that a patient remain a certain length of time pus-free before declaring a man cured. Keyes puts this at three months. By pus-free is meant neither free pus nor pus shreds in the morning urine or in the urine passed after massage of the prostate and seminal vesicles. If three months have not elapsed or if a patient has free-pus or pus shreds in his urine or pus in the secretion expressed from the prostate and seminal vesicles, then a negative culture or negative complement-fixation test is necessary to declare the patient gonococcus-free. Most cases of this class, if they still harbor gonococci, indicate it by having an acute exacerbation of the urethritis or by an attack of one of the complications of gonorrhea; seminal vesiculitis or epididymitis. These exacerbations are apt to follow sexual indiscretions, instrumentation, too violent exercise, or the immoderate use of alcohol.

**Complications of Chronic Posterior Gonorrhea.**—In acute flare-ups chronic posterior gonorrhea may present any or all of the complications of acute posterior gonorrhea. Practically the only other complication, if we except chronic seminal vesiculitis (p. 313), is contracture of the bladder neck (see Vol. II).

## SYMPTOMS OF SEMINAL VESICULITIS.

Caulk<sup>1</sup> gives a brief and pithy summary of the symptoms which may be caused by seminal vesiculitis:

"Various chronic discharges, many chronic bladder distresses; the numerous referred pains in the back, sacral region, hips, legs, perineum, groins, testicles, and penis; recurrent epididymitis and sexual derangements; a vast array of joint processes of an infectious nature, such as articular rheumatism, rheumatoid arthritis, arthritis deformans, and hypertrophic arthritis, numerous renal and cardiac complications, digestive upsets, and an array of nervous and mental manifestations which are almost inconceivable."

The finger passed into the rectum reveals an enlarged more or less tense seminal vesicle to the outer and upper angle of the prostate. The whole vesicle can by no means be felt. If a radiograph is desired the vas is exposed by a small incision in the scrotum and 10 per cent. collargol injected by means of a small needle into the cavity of the vas. This may be easily done after a little practice without incising the vas. Immediately following the collargol injection a radiograph is taken.

## TREATMENT OF GONORRHEA.

**Prophylaxis Against Gonorrhea.**—The real prophylaxis against gonorrhea, as suggested in another place, begins with the education of youth against promiscuous sexual intercourse.

The lesser and more uncertain prophylaxis is applicable to those who have indulged in promiscuous intercourse: (1) Prolonged sexual intercourse favors the acquisition of gonorrhea, as does also drunkenness on the part of the male; the latter because it increases congestion of the sexual organs and also tends to prolong intercourse. (2) Gonococci live in the alkaline semen, and the alkaline secretion of the urethral glands tends to keep them alive. They readily die in an acid medium; therefore the desirability of the subject urinating immediately after coitus (thus mechanically cleansing the urethra and saturating it with an acid urine). (3) Soap and water vigorously applied to the penile head probably cleanse better than antiseptics. The sooner they are applied the more certainty of killing the gonococci. In addition an antiseptic solution, such as bichloride of mercury, 1 to 2000, may be used to wash the head of the penis.

If the patient follows all this with urethral injections he may succeed in evading the enemy. Probably the best injections are a 0.5 or 1 per cent. protargol and 10 to 20 per cent. argyrol. These are carried in bottles and injected by means of a syringe or are put up in small collapsible tubes (one tube sufficing for one application) and injected therefrom. The army has used with a good deal of success calomel preparations. Henry<sup>4</sup> recommends the following:

Calomel . . . . .	50 grams
Vaselin liq. . . . .	80 c.c.
Lanolin . . . . .	70 grams

Sailors carry tubes of this, and part is injected into the urethra and part is smeared over the head of the penis. Henry tells of 529 sailors who were exposed to infection, only 4 of whom acquired gonorrhea.

*Hygiene Cleanliness.*—The instructions under this head apply particularly to cases of acute gonorrhea.

The end of the penis is washed in soap and water at least once a day. If there is a foreskin, this is retracted and well cleansed. The patient then thoroughly washes his hands with soap and water (individual soap and individual towel), and, while a patient very rarely infects himself ("in fifteen years of office experience I cannot recall a single case of conjunctival infection among the patients who came to see me with urethral gonorrhea"—Keyes), it is well to instruct the patient not to rub his eyes with his fingers.

*Discharge.*—If the discharge is slight, almost any dressing which prevents soiling the patient's clothes is sufficient. If it is profuse a strip of two-inch gauze bandage, perforated to admit the glans penis, is used. The gauze is slipped back of the corona and the foreskin is pulled forward, holding the gauze in place. Lacking foreskin, the penis is held in a gauze bag.

The patient is particularly instructed not to use a common bath tub while the acute discharge lasts and to keep the discharge away from the toilet seat. This to protect other members of the family.

*Rest.*—Much sleep; rest as much as possible; reduced physical exercise; riding instead of walking; no dancing; all of these are important. Under this head is sexual rest; erections are harmful. A suspensory bandage or jock-strap is advised in the acute stage.

*Food.*—Alcohol is absolutely contra-indicated. Spices are forbidden, although the writer believes that they rarely do harm. Coffee and tea should be used in moderation. Water should be much increased in an anterior gonorrhea; as the oftener the urethra is washed out by the diluted urine the better. In posterior gonorrhea, however, too much water may do harm. The frequency of urination that it causes may irritate the urethra.

*Bowels.*—At least one movement a day is necessary.

**Internal Medication.**—Balsamics:

*Compound Salol.*—Salol,  $3\frac{1}{2}$  grains; copaiba, 10 minims; oleoresin cubeb., 5 minims; pepsin (1 to 3000), 1 grain.

*Salol and Santal.*—Salol, 4 grains; oleoresin santoli, 5 minims; oleoresin cubeb., 5 minims; olive oil, 5 minims; pepsin (1 to 3000), 1 grain.

*Sandalwood oil*, 10 minims.

*Wintergreen oil*, 10 minims.

*Stearosan*, 10 minims.

All of these are given in capsule: One capsule three times a day after meals, with a full glass of water. There are many other combinations and many other more or less non-irritating preparations of sandalwood oil. These suffice, however.

I prefer compound salol or sandalwood. If these upset the stomach

I try stearoson or reduce the number of capsules or stop them entirely. If the sandalwood gives pain in the kidney regions, cut down or entirely withdraw the capsules, resuming the treatment carefully in a day or so. Any of these given over a long period loses its efficiency; therefore the need of changing them.

The rule for their administration is to give them as soon as the patient presents himself with an acute gonorrhea and stop (unless there is indigestion or kidney congestion) when the urine becomes clear (not meaning free from shreds).

*Anodynes.*—One of the standard anodynes which is given to decrease the pain on urination is the following prescription:

R—Liq. potassæ . . . . .	8- 25 gr.
Tr. hyoscyami . . . . .	15- 35 gr.
Aq. cinnamomi . . . . .	q. s. ad. 100 gr.
M. Sig.—Teaspoonful in water every 3 hours.	

This, as the prescription shows, combines an alkali with an anodyne. Alkalies alone may be given in the form of an alkaline water, or simple bicarbonate of soda. If there is much pain, as for instance occurs in prostatic abscess, morphin or one of its derivatives may be indicated. For prostatic pain and tenesmus, suppositories of morphin are often used. Morphin thus given probably does not act locally, but only quiets the pain after absorption. The morphin is therefore better given by mouth or hypodermically. Hot and cold water are excellent anodynes. Hot hip baths may be taken, with the water as hot as can be borne; or the patient may urinate while the penis is immersed in a vessel of hot water. Cold water is particularly useful in combating painful erections. Bromides are also used for this purpose: sodium bromide, grains 30, before retiring.

In the following pages certain methods of treatment are discussed. For the application of these methods see Case Treatment of Gonorrhea.



FIG. 164.—Urethral syringe.

*Anterior Urethral Injections.*—The patient uses an all-glass, two-dram, blunt-nosed, urethral syringe (Fig. 164). All-glass because it may be cleaned easily; quarter-ounce to prevent too large an injection; blunt-nosed to prevent hurting the urethra. He fills the syringe half-full of the solution which is in a bottle with a wide enough neck to admit the syringe. He urinates. The syringe is held in his right hand. The end of the penis is grasped behind the corona between the middle and ring fingers of the left hand. The urethral meatus is held open with the thumb and index finger of the same hand. The blunt nose of the syringe is firmly placed in the meatus and the injection slowly introduced. The syringe is removed and the meatus closed by the same

thumb and index finger and the fluid thus retained in the urethra. The perineal urethra is not compressed to prevent the fluid from entering the posterior urethra. This injures the urethra and excites, rather than hinders, the extension of the gonorrhea into the posterior urethra; forcing a gonococcus-laden injection into the posterior urethra and so causing a posterior urethritis is largely a myth. Injuring a urethra by a too large injection or by an injection violently given is another thing. The fluid is held in the urethra varying lengths of time, according to the injection used (silver salts for five minutes, or until they burn; astringent injections for one-half minute). The injection is used from one to three times a day. The syringe is washed in hot water at least once a day.

*Posterior Urethral Irrigation.*—The most satisfactory method of irrigating the posterior urethra is as follows:

A soft-rubber 16 F. catheter is introduced into the bladder. This catheter serves two purposes: (1) the irrigating solution is introduced through it into the bladder; (2) it acts as a sound and squeezes pus out of the ducts of the urethral glands, smooths down granulations, etc. The catheter is now withdrawn and the patient empties his bladder; so irrigating the urethra. Some recommend the insertion of the catheter as far as the posterior urethra, but not into the bladder, and then injecting the irrigating fluid. This seems to be a little more likely to harm the urethra than if the former method be used.

Another way of irrigating the posterior urethra is to force the fluid into the bladder without the aid of a catheter. The patient is told to relax the sphincters of his posterior urethra (he soon gets the knack) and then the fluid is forced into the bladder either by means of a large hand syringe whose blunt nozzle is inserted into the urethral meatus or by gravity. The gravity apparatus, about three feet above the level of the patient, is so arranged as to be elevated or lowered at will. In my experience this method is not so good as the catheter method.

The *most popular solutions* used are: Protargol, 1 to 400 to 1 to 200; silver nitrate, 1 to 10,000 to 1 to 1500; potassium permanganate, 1 to 5000 to 1 to 2000; zinc sulphate, 1 to 500 to 1 to 200; zinc permanganate, 1 to 4000 to 1 to 2000; silver permanganate, 1 to 4000 to 1 to 2000.

*Prostatic Massage.*—A finger cot is placed on the index finger of the right hand; the base of the finger cot is surrounded by cotton to protect the hand from being soiled. The protected finger is dipped in vaseline; the patient leans over the edge of a table or chair; the left hand is placed on the patient's left shoulder for leverage and the right index finger is inserted into the rectum as far as it will go. The upper margin of the prostate is felt and the massaging finger presses on the prostate as the finger is withdrawn; the right lobe first and then the left lobe is massaged downward in this way (Fig. 165). If in addition it is wished to massage the seminal vesicles, these are felt above the upper and outer angles of the prostate and pressed upon in that position. In

almost every case it is desirable to massage the prostate at the same time the seminal vesicles are massaged, because if there is infection of the latter there is always infection of the former. According to indications the massage varies from a gentle pressure on the prostate, lasting a second, to vigorous stripping of the prostate for one or two minutes. No matter how chronic the case, massage should always be very gentle at first.

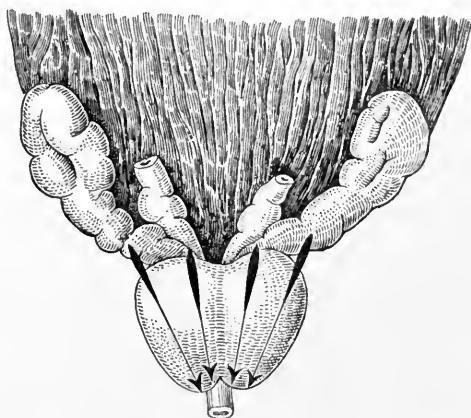


FIG. 165.—Massage of prostate. Arrows indicate direction and extent of prostatic massage. Prostate below, seminal vesicles and bladder above.

*Exploration with Bulbous Bougie.*—Some prefer a urethroscope, some a sound, and some a bulbous bougie in examining the urethra for patches of inflammation, granulations, etc. All instrumental examinations are, of course, reserved for cases of chronic urethritis. A bulbous bougie, metal or gum-elastic, as large as can be admitted into the urethral meatus is first used (Fig. 166). If the meatus will not admit at least a 24 F. bougie the meatus is cut (to 28 F.) and then the exploration is undertaken after the meatotomy wound has healed. The bulbous bougie is passed as far as the bladder



FIG. 166.—Olivary bougie.

neck and then gently withdrawn, and any strictures, roughenings, or granulations (which easily bleed) are noted. Sometimes because of strictures a number of different sizes of bulbous bougies are used.

*Dilatation by Sounds and Kollman Dilator.*—Either of these is indicated when the exploration of the urethra shows granulations, indurations, or slight strictures, or when the urine contains shreds which cannot be eliminated by irrigations, instillations, or prostatic massage.

When dilating by sounds we begin with the size of the bulbous bougie (the writer but rarely uses the bougie, preferring sounds, silk, or metal) used and increase it one or two numbers twice a week. If the increase in size causes much bleeding and pain we go very slowly and perhaps reduce the size of the sound. Sounds best adapted are those with the Beniqué curve. The size of the sound used is limited

by the size of the meatus. Therefore, when a small meatus is present or when more dilatation than sounds will produce is wished we use a Kollman dilator (Fig. 167). The dilators best adapted are those with the Beniqué curve.

Kollman dilatation takes place twice a week, and the first dilatation is such as to cause the patient slight pain and slight bleeding. Thereafter the dilatation progresses much more rapidly than with sounds.

When shreds come from the posterior urethra, dilatation is often alternated with prostatic massage.

*Contra-indication to Dilatation.*—When the urine is cloudy with pus, dilatation should rarely, if ever, be made. Dilatation should not be begun until the urethra has become accustomed to less vigorous instrumentation, such as that by passage of rubber catheters.

*Urethral Instillations.*—By means of special instruments a small quantity (1 or 2 c.c.) of a solution is distributed along the urethra. The instrument used is the Keyes or Guyon instillator, which is a 2 c.c. syringe attached to a hollow sound, 16 F. size (Fig. 168). This is filled with the solution and the instrument introduced into the urethra in the same manner as a sound, until the tip is just beyond the cut-off muscle in the posterior urethra; one can generally feel the instrument jump slightly when passing the cut-off muscle. Half the solution is injected with the instrument in this position and the remainder injected as the instrument is withdrawn.

*Use.*—Instillations are generally used in chronic inflammations of the urethra. In these cases after the urethra has become accustomed to urethral washes larger in quantity and milder in strength than the instillations, one instills a 0.25 or 0.5 per cent. silver nitrate, 1 to 5 per cent. copper sulphate, or other solution. Sometimes instillation are given in cases of subacute urethritis, using either protargol, 5 to 10 per cent., or argyrol, 10 per cent. and upward.



FIG. 167. — Kollman posterior urethral dilator, Guyon curve.

**Case Treatment of Gonorrhea.**—CASE I.—*Acute Anterior Gonorrhea.*—The patient had a slight urethral discharge of one day's duration. Incubation four days. His first gonorrhea. Neither burning nor urinary frequency. Discharge contained pus cells and many typical intracellular gonococci (methylene-blue stain). Meatus slightly red. First urine cloudy; many shreds. Second urine clear.

This being the patient's first gonorrhea, his urethra is particularly vulnerable to infection and we may expect an acute and long attack. On the other hand, he came on the second day of his discharge before any acute symptoms had set in, and some days before the height of the inflammation. In this stage the gonococci are mostly along the surface of the urethra, having only slightly penetrated the epithelial layer, and are probably not yet in any of the crypts. Therefore they are easily accessible and in a position to be readily killed.

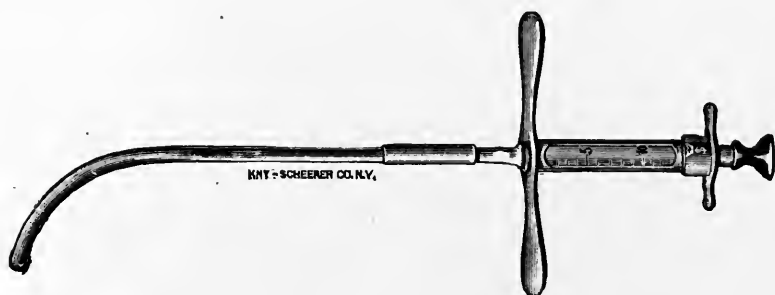


FIG. 168.—Keyes' deep urethral syringe.

Should one of the so-called abortive treatments be used?\* The answer is in the foot-note.

An anterior injection of 0.5 per cent. protargol† is given to the patient, and he is told to use this three times a day, and given compound salol capsules. On the second day the discharge is less, urine is clear but contains shreds; continue treatment. On the sixth day the discharge is slight.

\* *Abortive Treatments.*—These are recommended by many urologists and are applied to cases like the above in which the discharge has persisted for but two or three days. In most of the various modifications a strongly caustic solution—5 to 20 per cent. silver nitrate is a favorite—is injected into the anterior urethra with the idea of killing all the gonococci at one fell swoop (by some a urethroscopic application instead of injection is recommended). The unfortunate part played by these treatments is that they fail in a goodly percentage of cases to kill all the gonococci and they invariably do much damage to the urethra. With the few gonococci left this damaged urethra is as a virgin field; and the ensuing gonorrhea is much worse than it would have been had the patient been left entirely alone.

*If any attempt at abortive treatment is to be made a gonococcicide must be chosen that does not harm the urethra.*

† *Organic Silver Salts.*—There are many of these on the market. Protargol seems by all means the best. Argyrol in a 5 to 10 per cent. solution often works well in early cases as an anterior injection. It is less irritating than protargol and for that reason many prefer it in the acute inflammatory stage, later changing to protargol when the argyrol ceases to be effectual. Some skip the protargol and change to one of the astringent injections. All organic silver salts should be made up fresh. After being a week in solution they deteriorate.

It is examined and gonococci are found in one pus cell as against many gonococci at the time of first examination. The patient is seen only every other day. Increase strength of anterior protargol injection to 1 per cent., as the 0.5 per cent. held in five minutes does not irritate.

By the eleventh day he had no discharge. Urine showed only a rare shred; no gonococci found. On the fifteenth day internal medication and injection discontinued. Twenty-sixth day urine clear, no shreds.

*Proof of Cure.*—The patient now has the choice of (a) having a bacteriological examination made. If this proves to be negative he is discharged. This examination is preceded by a gentle massage of the anterior urethral glands, which are emptied of their contents by milking the anterior urethra from behind forward; and also of the prostate, because one cannot be sure that the urethritis has remained wholly anterior. Or (b) he is told to wait at least two months, at which time if his urine is pus-free he is discharged.

*Irrigation of Janet.*—Instead of using a silver salt as an internal injection in this case the Janet method of potassium permanganate injection might have been used. This method is used by a great many urologists and in a great many urological clinics.

As far as my experience has been with the method it rapidly checks a urethral discharge, but the gonococci persist in the urethra much longer than when the silver salts are used.

Keyes describes the method of Janet: "He irrigates the anterior urethra twice a day for three or four days, then increases the interval from twelve to eighteen hours. When the cloudiness of the first urine is pretty well gone he makes the interval twenty-four hours. When the discharge is no longer purulent he makes it forty-eight hours.

"When the second urine becomes cloudy he irrigates the posterior urethra according to the same method, twice a day at first, later every day or every other day. For each irrigation of the posterior or anterior urethra he employs 500 c.c. of fluid at a temperature of 110° F.

"If the case is seen before the appearance of marked inflammatory symptoms he employs a 1 to 500 solution of permanganate, immediately followed by a like quantity of boric acid solution. If this does not prove too irritating he continues at this strength until the inflammation has subsided sufficiently to permit intervals of thirty-six to forty-eight hours, when he drops to 1 to 4000 or 1 to 6000 permanganate and omits the boric acid.

"If the posterior urethra becomes inflamed he begins irrigating it with solutions of 1 to 4000 down to 1 to 10,000. If these are well borne he increases the strength to 1 to 3000 or 1 to 1000 and follows it with a boric acid irrigation.

"If the patient is first seen after the appearance of acute inflammatory symptoms the irrigation is begun at 1 to 10,000 to 1 to 4000 strength, and only for the anterior, even if the posterior urethra is inflamed. He begins treatment of the posterior urethra only when the anterior inflammation is under control.

"In the declining stage he gives a daily irrigation of 1 to 6000 to 1 to 8000."

*Other Methods.*—Valentine and the other followers of the Janet method in this country adopt his treatment with certain variations. They usually employ much weaker solutions (1 to 4000 to 1 to 20,000) and larger quantities (1000 c.c. or more), and often irrigate the posterior urethra every day or every other day as a routine measure.

The method in which this Janet irrigation is used is the following:

The solution is put in a wall tank which can be easily raised or lowered (the height is about three feet above the level of the patient); from the lower part of the tank runs a rubber tube, on the end of which is a blunt-glass or soft-rubber urethral nozzle.

There are two-way nozzle devices by which a continuous inflow and outflow may take place. The best way, however, is to allow the urethra to fill up with the fluid, then withdraw the nozzle and allow the fluid to flow out. Instead of the wall tank a hand syringe may be used.

CASE II.—*Acute Anterior and Silent Posterior Gonorrhea.*—Patient came with his second gonorrhea. His discharge of three days' duration contained many gonococci (methylene-blue stain). Meatus is red-dened. First urine cloudy; second urine clear. This case was put on exactly the same treatment as Case I. In three weeks he had only pus shreds in his clear first urine; in some of these shreds typical gonococci were found. I increased the strength of his anterior injection to 1 per cent. protargol, and then because this caused no burning to 2 per cent. The shreds still persisting, I changed the injection to astringent zinc and lead\* and inquired carefully as to the patient's getting up at night to urinate (generally the first hint of a posterior urethritis). Finally, because of the persistence of the urethritis, I gently felt his prostate, which was not enlarged, but I massaged from it pus cells (page 310).

His anterior urethritis had crept back into his posterior urethra without giving the usual disturbance to urination, and the prostatic involvement was the cause of his persistent urethritis. Because his prostate was not enlarged, and because of the mildness of the urethritis, I did not immediately put the patient on prostatic rubs, but instead gave him bladder washes (every second day) of 0.5 per cent. protargol for once or twice and then silver nitrate solution, 1 to 10,000 at first, increasing until 1 to 2000 is used. This increase in strength occurred

\* *Astringent Injections*—These are used in the anterior urethra (as a hand injection) in subacute and chronic anterior gonorrhea and in non-gonorrheal urethritis. The one most used by me is

R—Zinc sulphatis . . . . .	0.25 gr. iv
Liq. plumbi subacetatis dil. . . . .	100.00 ʒ iij
Sig.—Shake. Inject morning and night.	

Other solutions are zinc sulphate 1 to 500 to 1 to 100; potassium permanganate 1 to 3000 to 1 to 5000. There are many others. They are held in the urethra about half a minute. It is well to remember that both astringent injections and silver salt injections may keep up a urethral discharge. If the discharge does not diminish or cease when hand injections are used totally withdraw, for a time at least, these injections.

in about four or five washes. The patient should have after each silver wash a slight feeling of warmth in the urethra, but no vigorous burning.

After the third or fourth silver wash the patient's urine completely cleared. In a week he was pus-free (both morning urine and urine passed after prostatic massage) and in four weeks his complement-fixation test was negative.

CASE III.—*Acute Anterior and Posterior Gonorrhea*.—The patient came with the second gonorrhea (twenty-four hours' duration, seven days' incubation); burning on urination; no frequency; smear showed pus cells and gonococci (methylene stain); first urine cloudy; second clear. His treatment was anterior injections of 0.5 per cent. protargol and compound salol capsules.

The patient, instead of using a urethral syringe, used an eye dropper to inject himself. This resulted in trauma of the urethra with bleeding and a rapid extension to the posterior urethra, which extension was revealed by clouding of the second glass of urine and by the patient's getting up twice at night to urinate and increased pain on urination. Injections were stopped temporarily. His pain grew much less. In one week he was again put on anterior injections of protargol. Within two weeks his urine became clear and contained but few pus shreds. Bladder irrigations of silver nitrate 1 to 10,000 were very gently started. After two or three of these his urine was absolutely clear and massage of the prostate showed no pus in the prostatic secretion.

One month later his complement-fixation test was negative.

CASE IV.—*Acute Anterior Gonorrhea and Acute Prostatitis*.—The patient had a urethral discharge five days; two days' incubation. This is the second gonorrhea; the first occurred eight years ago and lasted months because of many exacerbations. First urine cloudy; second urine clear. Slight discharge contains rare pus cell, a few of which are filled with gonococci. (methylene-blue stain). Meatus not red. This is apparently a new gonorrhea. Because of the slight amount of pus in his first urine (an active case usually has a cloudy urine on the fifth day), and because of a short incubation, it was thought that this might be an exacerbation of an old gonorrhea; so his prostate was gently massaged and in the discharge a few pus cells were found (by a few pus cells is meant eight to ten to the field, using one-fifth objective) and here and there a number of leukocytes were clumped together. I still was in doubt as to whether or not this was a new gonorrhea. So I took a complement-fixation test, which would be positive if it were a reinfection. His test was negative.

He was treated with great care because of the difficulty in curing his first attack. The case was treated as Case I, and at the end of three weeks his urine was clear, with a rare shred and no gonococci found.

He was seen infrequently now, and at the end of six weeks his urine still remained clear. Because of the old attack a sound (24 F.) was gently passed into the bladder to learn the condition of his urethra.

Much bleeding resulted, from granulations in his bulb left by the first gonorrhea. Thereupon he developed a severe posterior urethritis and prostatitis, due to the sounding and the extension of his uncured anterior gonorrhea into his posterior urethra. Profuse discharge; first and second urines cloudy; prostate large, hot and tender. Urinated every hour, day and night, with much pain.

He was put on the palliative treatment of prostatic abscess.\*

This patient used hot rectal irrigations very frequently; also morphin to control the pain. More than once I was moved to suggest operation on his prostate because of the intense pain, which was more or less continuous for two weeks.

I put him on vaccines in the second week, but they had little effect (in another case, less acute, vaccines seemed to control the pain). He had no chills, and his temperature kept around 101° F.

At last, however, the pain broke. Then he was put on sandalwood oil and rectal irrigations but once a day. This was continued for a week. Now rectal irrigations were stopped. He was kept on a balsam for nearly three months, during which time he had slight exacerbations of prostatic pain and pus in his urine. At the end of three months his urine was clear, rare pus shred, no gonococci found. Complement-fixation test positive. Therefore gentle massage of his prostate twice a week was began; at first without irrigation, and later with potassium permanganate solution 1 to 5000 in his bladder (by catheter). Two months later his blood became doubtful, which meant cure.

CASE V.—*Prostatic Abscess*.—The patient came with a history of an acute exacerbation of an old posterior gonorrhea. He had a slight discharge which contained extracellular gonococci (methylene-blue stain) but not sufficiently typical to be called gonococci; so a Gram stain was made. This showed gonococci. He had much pain in his

\* Palliative Treatment of Prostatic Abscess.

1. Rest in bed and daily catharsis.
2. Stop all urethral injections.
3. Rectal douche.

By means of hot (rarely cold) water applied rectally, acute inflammation of the prostate, prostatic pain and vesical tenesmus are often controlled. Any two-way tube (one for inflow and one for outflow) which may be introduced into the rectum for an inch or two suffices. The most satisfactory is the Chetwood. This costs about \$1.50 and is made of glass. A single rectal tube, such as comes with an enema outfit, may be used. With this hot or cold water is allowed to flow into the rectum; then by disconnecting the tube the water is allowed to flow out again, and so on. The bag containing the water should be two or three feet above the level of the anus. With any apparatus a number of trials on the part of the patient are necessary to get the tube working properly. The seat of the toilet is the best place for administering the therapy. At least two quarts of water should be used either at as hot a temperature as can be borne by the hand, or as cold as runs from the tap. A teaspoonful of salt may be added to the pint. This salt solution is supposed to be non-irritating. Such irrigations should be given as often as three times a day, if the patient's acute symptoms demand it; otherwise not as often. Hot irrigations are always tried first, and if these have no effect on the prostatic pain, or urinary frequency, change to cold.

4. Hyoscyamus mixture or morphin to alleviate the painful urination.

5. If the patient has complete retention of urine, he should be gently catheterized three times a day. It is probably better not to follow the catheterism with a bladder wash. If a bladder wash is given, however, a very mild antiseptic solution should be injected through the catheter and allowed to flow out and the catheter then removed.

prostate; he urinated day and night, every three-quarters of an hour; prostate large and irregular and periprostatic tissues infiltrated; temperature 99° F.; no residual urine. He was put on the palliative treatment of prostatic abscess.

The following week his temperature steadily rose until it reached 103° F. He had much pain in the urethra and in both groins. At the end of this week his prostatic abscess was drained through the urethra;\* no free pus obtained, but broken-down material evacuated from his prostate.

He went home on the sixth day after operation. Before going home his testicles were well strapped up; notwithstanding this he had an epididymitis which responded to rest in bed and heat. His perineal fistula rapidly healed, and he was left alone for two months, when pus was found in his prostate and his complement-fixation test was positive.

Notwithstanding bi-weekly rubs of his prostate, followed by permanganate potassium (1 to 4000) in his bladder, a positive complement-fixation test persisted for six months.

Treatment was given up after three months and he was told to get himself in good physical condition and to depend upon this to rid him of his last gonococci. His complement-fixation test was finally negative.

*CASE VI.—Acute Anterior and Posterior Gonorrhea; Acute Gonorrheal Arthritis.*—The patient came with a history of his second gonorrhea (two weeks' duration) complicated by an acute general arthritis which began two days previously. His arthritis was mostly in the small bones of the feet. His very profuse discharge contained gonococci; first and second glasses very cloudy. Meatus very small (about 12 F.). This was immediately cut to 24 F., and just behind the meatus was the opening of a perimeatal gland from which pus could be squeezed. The duct ran just under the mucous membrane of the urethra. This duct was opened up so that its cavity communicated freely with the urethra.

Because of this slight operation, which gave free drainage for the gonorrheal pus, the arthritis immediately cleared up and the patient's gonorrhea promptly improved. Within two weeks he was put on a protargol anterior injection and sandalwood-oil capsules. In two weeks he had only a morning drop, with clear urine and shreds in the first. A sound was passed to the posterior urethra and caused undue bleeding

\* *Operative Indications and Operation for Prostatic Abscess.*—If the complete retention is not relieved in a very few days, if the temperature remains persistently above 100° F., if there are chills, then the prostatic abscess should be operated upon.

*Operation.*—The urethra is opened by perineal section. (See Chap. XI.) The index finger is introduced into the prostatic urethra and the other index finger introduced into the rectum and the lobes of the prostate palpated between them. The lobes of the prostate are now entered by the urethral finger and any abscess cavity evacuated. If the abscess has broken beyond the confines of the prostate and has pointed in the perineum, wide incision and drainage are indicated. A perineal drainage tube is inserted into the bladder and removed in twenty-four hours. A patient can often leave the hospital in a week. He must be careful, however, as epididymitis often follows indesections. The perineal wound should heal in three or four weeks.

in the bulb, where a slight constriction was found. The 24 F. sound was grasped on withdrawal.

His posterior urethra was therefore irrigated every other day with silver nitrate solution beginning 1 to 10,000 and reducing to 1 to 2000. This course was followed to accustom the urethra to instrumentation so that the Kollman dilator or sounds could be used. These were indicated because of the slight strictures and granulations which were found by the sound. He was stretched with a Kollman dilator twice (to 30 F. then to 34 F., an interval of one week between stretchings). This cured him.

CASE VII.—*Persistent Complement-fixation Long after an Apparent Cure.*—This patient came with an acute anterior gonorrhea. In one month his urine was clear; there were a few pus cells in his prostate. He was told to return for a complement-fixation test. He did not return until nearly two years later, when he wished the test preparatory to marriage. In the interval, as far as I could ascertain, he had no symptoms and no new attacks of gonorrhea. He had a very few pus cells in his prostate; no gonococci were found in these, but his complement-fixation was positive. A positive complement-fixation persisting as long as this means that the patient harbors gonococci. His prostate was massaged but three or four times; the massage was followed by bladder irrigations; one month later his complement-fixation was doubtful and one month later negative. This shows the extraordinary efficiency of prostatic massage in some cases; all cases do not react to massage as well as this!

CASE VIII.—*Gonococcal Reinfection of the Urethra.*—The patient had a urethral discharge for four days. This was his third gonorrhea; the last one occurred one year previous. Incubation of this attack one day; meatus not red. No burning on urination. Discharge showed one or two cells which contained gonococci. He gave a history of a number of these attacks, each of short incubation. Because of this history, and because he had not had a red meatus, and because of the difficulty to find typical gonococci in the discharge, it was thought that this was a reinfection of the urethra from an old prostatic gonorrhea. His prostate was gently rubbed, therefore, and the drop of pus expressed from it showed typical gonococci. He was put on anterior injections of protargol which within three or four days entirely cleaned up his urethral discharge. Then because of prostatic infection, a catheter was very gently introduced into his bladder and 0.5 per cent. protargol injected, and the patient passed this out. As this gave no reaction, his prostatic massage was gently begun, followed by a mild permanganate bladder wash, 1 to 4000. A month of this (twice a week), with the prostatic massage increasing in severity, cleared his prostate of pus, and a month later his complement-fixation test was negative.

CASE IX.—*Peri-urethral Abscess.*—This case came with a history of gonorrhea of two weeks. For three days he had a swelling on the under surface of the penis two inches back of the end. This was evidently a gonorrheal abscess of a peri-urethral gland. It was defin-

itely pointing and was incised\* the pus evacuated and the urethra wrapped in a wet bichloride dressing. No urethral treatment was given until the abscess healed—about two weeks. Then the treatment did not differ from that of any anterior gonorrhea.

CASE X.—*Non-gonorrheal Prostatitis and Infection of the Verumontanum*.—This patient came with a morning urethral discharge which had persisted since his second attack of gonorrhea two years previous. His urine was clear and contained many shreds. When a discharge persists for this length of time it generally means a prostatitis. Therefore his prostate was examined. His prostatic secretion showed much pus. Blood for complement-fixation was negative for gonococcal infection. This was therefore a comparatively harmless, postgonorrheal prostatitis. The prostate was rubbed twice a week. Each rub was followed by an instillation of silver nitrate (0.25 to 0.5 per cent.) or a potassium permanganate bladder wash 1 to 4000 or 1 to 5000. These were continued for a month, changing occasionally to the Kollman dilator. His discharge by this time was reduced to a morning drop, which no slight-of-hand of mine seemed to be able to cure. I urethroscopied him and found a large and boggy verumontanum. This was probably the explanation of his infection, so I burned it with acid nitrate of mercury. The discharge still persisted, however, and I apparently was unable to cure it.

CASE XI.—*Postgonorrheal Neurosis*.—Patient came complaining of a pain in his deep urethra. He had a gonorrhea seven years previous and a second one five years later which, because of the above pain, he believed still persisted. His urine was clear and contained a very large number of shreds which, under the microscope, showed no pus. He has few pus cells in his prostate. A year previous his blood gave a negative complement-fixation test. Urethroscopic examination shows a few papillomata just back of the verumontanum. These were destroyed by touching them with acid nitrate of mercury. When he was examined again three weeks later his papillomata were cured, but his pain was still present. This is characteristic of these cases. Even if the cause for a neurosis is found and removed the symptoms, especially that of pain in the urethra, very often persist indefinitely.

CASE XII.—*Cured Gonorrhea*.—This patient came asking for guarantee of cure from a gonorrhea which he had five years ago. His present urine was absolutely clear; no shreds. The urine passed after vigorous massage of the prostate and vesicles showed on centrifuging absolutely no pus. He was guaranteed to be free without a complement-fixation test.

CASE XIII.—*Incrustation of the Urethra Causing Urethral Discharge*.—The patient came because of a slight morning urethral discharge

\* *Operative Treatment for Peri-urethral Abscess*.—These abscesses are allowed to point and then, under aseptic precautions and local anesthesia, are incised. The incision is parallel to the course of the urethra, wide, and extends down to the bottom of the abscess. Unless these peri-urethral abscesses are the result of a stricture or prostatic abscess, no perineal section with drainage of the bladder is necessary.

containing pus and epithelial cells, but no gonococci; his complement-fixation test was negative, and there was no pus in a drop massaged from his prostate. He was stretched with the Kollman dilator and the bladder irrigated with various solutions—permanganate 1 to 4000, silver nitrate 1 to 2000, and he was given instillations of 0.5 per cent. silver nitrate. All of this had no effect on his urethral discharge. He was then urethroscoped and in his bulb were a few ulcers of the mucous membrane with calcareous deposits on them. These were scraped off with a cotton swab and the ulcers touched up with 10 per cent. silver nitrate (through the urethroscope). His discharge immediately stopped and he was cured.

**Vaccines and Vaccine Therapy.**—The fact that gonorrhea is in most cases a localized and not a general infection explains the reason why vaccines are rarely used with success in combating this disease. The more general the gonorrhea, the more hope of success of any vaccine therapy. Thus cases of gonorrheal arthritis should, and often do, yield to vaccines; while cases of epididymitis or prostatitis rarely show improvement.

Nevertheless in some intractable cases of both prostatitis and epididymitis it is well to try the effect of vaccines.

Because different strains of gonococci are used to prepare the antigen used in the complement-deviation test, it is plausible that a vaccine prepared from different strains of gonococci might work better than a one-strain vaccine. Many prefer such a "polyvalent" vaccine and report favorable results from its use.

Another method is to try on both animals and patients the efficacy of vaccines made of different strains of gonococci and use the strain which proves most efficacious.

**Dosage.**—Always start with a very small dose, because we do not know how a particular individual is going to react.

A gonococcal vaccine is used in which 1 c.c. equals 100,000,000 to 500,000,000 of dead gonococci.

Begin with 1 to 20,000,000 and repeat every fourth day, gradually increasing the dose according to the way a patient reacts.

**Autogenous Vaccines.**—Many prefer these to regular stock vaccines. The objection to them is that it takes some time to have them made up. Their dosage is the same as that of stock vaccines.

**Antigonococcus Serum.**—Rogers and Torrey have derived from rams a polyvalent serum which has been used in cases of gonorrheal arthritis and epididymitis. Two c.c. of this serum are injected every second or third day, generally intramuscularly.

Those using the serum report much the same result as those using vaccines. The serum injections, unlike the injection of the vaccines, may be followed by redness and swelling at the point of injection, chills and temperature.

To sum up, both vaccines and sera are uncertain in their action; generally have, as nearly as can be determined, absolutely no result; and rarely, only too rarely, achieve a brilliant cure.

### TREATMENT OF SEMINAL VESICULITIS.

The treatment is non-surgical and surgical. The *non-surgical* means of curing a seminal vesiculitis are similar to those for curing a prostatitis. Rectal injection of hot water; massage of the seminal vesicles (with great care if the condition is at all acute), urethral washes to get rid of the débris massaged out of the vesicles, etc.

Squier classifies the indications for *surgical* treatment under three headings—pus, pain and rheumatism.

1. Under the first he includes (a) the acute cases, developing in the course of gonorrhea, often mistaken for prostatic abscess, in which the perivesiculitis simulates prostatic enlargement; (b) cases of recurrent epididymitis following acute urethritis and vesiculitis; (c) cases of chronic vesiculitis which simulate spermatorrhea; and (d) those in which the discharge from the urethra occurs during defecation and those in which non-operative treatment has been faithfully carried out.

2. Under pain he includes various referred symptoms (p. 313). He reserves surgery, for cases which resist local treatment.

3. In the rheumatic group he includes acute, subacute, chronic, and the deforming types of arthritis in which a definite relationship can be determined between the joint and the vesicle.

Cabot reserves operation for cases of crippling arthritis.

**Operations.**—I shall again follow Caulk in describing the operations on the vesicles. These may be divided into:

“Vasotomy with injections of the vesicles, vesiculotomy, and vesiculectomy. Vasotomy, heralded by Belfield, has been employed by him in many cases of vesiculitis. It does not at present seem to have a substantial hold on the profession in the surgery of these organs. He has reported excellent results and others have corroborated his statements. The technic is simple, consisting in making a small scrotal vasotomy and allowing argyrol, collargol, or some other solution to find its way into the cavities of the vesicles. Owing to its simplicity it seems to be an operation which should be more frequently employed, and seems indicated particularly in many of the cases of chronic discharges which are not benefited by local treatment.

“Seminal vesiculotomy and vesiculectomy may be performed either perineally or through the ischiorectal region. The perineal approach is by far the most commonly employed. The usual steps are as follows: with the patient in the lithotomy position, a Y-shaped incision is made similar to Young’s perineal incision for prostatectomy; the apex of the prostate is exposed, then there are various modifications by different men. In order to bring down the vesicles, Young uses a tractor similar to the one he employs in prostatectomy work, excepting that it is longer and passes directly into the bladder from the meatus. By means of rotating this instrument against the symphysis, he is able to bring the vesicles nicely into the wound, and he is at liberty to undertake whatever he deems necessary.

Squier, after exposing the apex of the prostate, and by traction, is

able to pull the vesicles down for a satisfactory exposure. After the apex of the prostate has been exposed, and either the tractor or the tape is inserted, the prostate is brought into the wound and the rectum separated, dissection being between the two layers of Denonvillier's fascia. When the vesicles are exposed they will be found to be covered by the same fascial layers between the two layers which cover the prostate. These must be divided before the vesicles can be attacked. After division of the fascia, the prostate vesicles and vas can be examined. There is usually a perivesicular exudate which occasionally makes exposure difficult. One can then open and drain the vesicles in any place desired, or can remove any part of the vesicular wall which may be indicated. It is very frequently necessary also to incise the ampullæ of the vasa. This operation should be used on both vesicles and vasa. After one has incised the vesicles, the operation may be considered complete, or the prostate may also be drained at the same time if it seems advisable. Tubes and gauze drainage are used. The gauze should be placed in the incised cavities and the tube down to this point. The wound is partially closed by bringing together the levator and muscles with catgut, and the skin with either catgut or silk.

In Fuller's operation for seminal vesiculotomy the patient is placed in the knee-chest position, thigh and knees sharply flexed, the knees well separated. He makes a cut on either side of the anus, taking care not to injure the sphincter. The forefinger is inserted into the rectum, and acts as a guide to prevent injury to the rectum. The levator ani muscles are cut; then the space between the prostate and rectal wall is dissected bluntly with the finger, and the tip of the seminal vesicle exposed. Along a grooved director passed to the vesicle, the vesicle is incised. The cavities of the vesicles are packed with gauze. Fuller has done this operation about 200 times.

*Operations on the Vas Deferens.*—If the operation for relief of sterility following double epididymitis (p. 328) is excepted, the two principal operations on the vas are vasotomy and vasectomy. Vasotomy has been employed by Belfield, Cabot and others for the injection of silver salts into the seminal vesicles for the treatment of various affections of these sacs. The vas is grasped between the finger and thumb, and raised until it is just underneath the scrotal skin. The skin is excised over it, and the vas exposed.

*Vasotomy* is unnecessary in most cases because, with very little practise, a fine needle may be inserted into the lumen of the vas, and fluid injected without incision.

*Vasectomy* has been used on men so old as to have lost the power of procreation, and who have recurrent attacks of epididymitis secondary to infection of the posterior urethra and bladder. The incision is the same as in vasotomy, and both of these operations may be done under local anesthesia.

Vasectomy has also been suggested and used for the sterilization of criminals and the unfit.

### GONORRHEAL EPIDIDYMITIS.

Acute gonorrheal epididymitis is the most frequent complication of posterior urethral gonorrhea, and is also the most frequent disease of the testicle. This disease is important because it not infrequently results in obliteration of the vas deferens, thereby preventing spermatozoa from reaching the seminal vesicles and urethra. If the disease is bilateral and severe enough to cause obliteration of both vasa deferentia, sterility results.

**Etiology.**—Gonorrheal epididymitis is always preceded by a posterior gonorrheal urethritis; while this posterior urethritis is generally acute, it need not necessarily be so. The epididymitis may simply occur in the course of a posterior urethritis, or more often is caused by improper instrumentation (passage of a sound, etc.), or the trauma following prostatic massage. Trauma of the testicle, itself, may be a predisposing factor. It occurs in from 20 to 30 per cent. of all cases of gonorrhea, although one is apt to see it much more often in clinics than in private practice. "When the epididymitis precedes the urethral discharge, as it sometimes does, we have to do probably with a relapsing gonorrhea and not with a new infection." (Keyes.)

**Pathology.**—The inflammation running down the vas deferens attacks the globus minor first; it may stop here, but it generally goes on and attacks the globus major. The seminiferous tubes are swollen, edematous and infiltrated; abscess formation is rare; resolution generally takes place. According to the length and the severity of the inflammation, more or less fibrous tissue is formed. Many tubules may be obliterated and the lumps in the epididymitis may take a number of months to finally resolve. The testicle proper is practically never involved.

**Symptoms.**—*Local Symptoms.*—The testicle presents all the evidences of acute inflammation: Swelling, often redness, edema of the skin and tenderness. Because the infection travels down the vas, the pain and swelling are generally first felt in the tail of the epididymis; thence the swelling may extend to the head of the epididymis and back along the cord. The swelling of the cord often causes very intense pain because of its strangulation in the external abdominal ring. After a number of days, sometimes a week or more, the pain and swelling subside. Not infrequently acute epididymitis of the opposite side follows, but both testicles are very rarely involved at the same time. The urethral discharge and cloudy urine may entirely clear up during the course of the epididymitis and may recur again with the fading of the inflammation. In a certain number of cases, however, acute epididymitis causes a temporary cessation of the urethral discharge. Relapses occur in a number of cases.

*General Symptoms.*—These are fever, generally not above 100° F., and the other constitutional symptoms of a mild infection.

**Diagnosis.**—When a patient has a gonorrhea which is followed by acute epididymitis the diagnosis is not difficult. Occasionally, how-

ever, when the epididymitis is subacute, it is difficult to differentiate it from a tuberculosis or a colon bacillus infection of the epididymis. Careful examination of the centrifuged urine for the gonococcus, the colon bacillus or tubercle bacillus and palpation of the prostate and seminal vesicles help to determine the nature of the process. In certain rare cases the use of tuberculin for diagnosis probably assists.

Beer\* cites one case in which a distinct focal reaction followed the injection of tuberculin. The epididymis became more swollen and painful. The writer has lately had a case which gave a general tuberculin reaction which was followed by no focal reaction in the involved epididymis. This epididymitis eventually cleared up and was probably a colon infection.

The complement-fixation test should not be neglected in making the diagnosis; it is invariably sooner or later positive (generally within two weeks after the beginning of the epididymitis). Syphilitic testicle, malignant disease of the testicle, and other rarer conditions are to be thought of.

**Prognosis.**—Death rarely is caused by gonorrheal epididymitis; there are, however, a few fatal cases recorded in which death from peritonitis or pyemia followed.

Watson and Cunningham† quote Benzla who “investigated the number of offspring begotten by the soldiers of the German Army who had had gonorrhea, and found that 10.5 per cent. of those who had the disease without epididymitis were childless, while of those who had unilateral epididymitis 23.4 per cent. were childless, and those with bilateral epididymitis 41.7 per cent. were childless.” Keyes states that “patients who have recurrent attacks of epididymitis are less likely to be sterile than those who have but a single attack.” The reason for this is obvious. If the epididymitis has closed the vas deferens in the first attack, the gonococci cannot again come through the vas and cause a second attack.

**Treatment.**—The first prophylactic measure is to prevent if possible an anterior gonorrhea from extending into the posterior urethra. The second is, if posterior gonorrhea has become established, to be cautious and gentle in entering the posterior urethra with instruments. During the acute stage of the gonorrhea no instrument should be put into the urethra, and the prostate should not be massaged. A suspensory is also advised, but it is a question whether it ever prevents the occurrence of an epididymitis. When once the epididymis is inflamed the following measures should be taken. The patient should be put to bed and kept there until the temperature is normal and acute pain has subsided. The testicles should be elevated as much as possible. To do this a suspensory bandage or jock-strap is inadequate. Alexander improvised the following suspen-

\* The Use of Tuberculin in the Diagnosis of Obscure Conditions of the Genito-urinary Tract, *Med. Record*, October 11, 1913.

† *Genito-Urinary Diseases*, Lea & Febiger, 1908.

sory, which is still used at Bellevue Hospital. A broad bandage of cotton flannel is pinned around the patient's waist. The cross bar of a T-bandage is made of folded gauze and is 2 feet long by 5 inches wide. The vertical portion of the T is divided into two muslin strips each 2 inches wide by 2 feet long; these are used as perineal straps. The gauze portion is pinned snugly around the scrotum and penis, the perineal straps pinned to the waistband, behind, and the testicles are elevated by pinning the ends of the gauze to the waistband. As far as I know this is the only method by which the testicles can be properly elevated, and is much better than the old method of placing a broad band of adhesive plaster across the thighs and allowing the testicles to rest on this. External application of heat or cold may be applied to the testicle. This apparently does not particularly influence the inflammation but lessens the pain. The same is true of applications of various irritative drugs applied to the scrotum. A favorite one is 50 per cent guaiacol in glycerin; this relieves the pain but I doubt if it hastens the recovery. It irritates the scrotal skin.

Barney\* has devised a rubber bandage which is so placed around the testicle as to exert a uniform pressure on it. The author believes this is the best method of treating acute gonorrheal epididymitis.

*Vaccines.*—Many recommend vaccines beginning with 20,000,000 bacteria and repeating every second day in ascending doses. Occasionally they do good, but more often not.

*Operative Treatment.*—Hagner first suggested the following operation for acute epididymitis:

"At the juncture of the swollen epididymis and testicle, an incision 6 cm. to 10 cm. in length, depending upon the amount of enlargement, is made through the scrotum down to the tunica vaginalis, which is opened at the juncture of the epididymis and testicle. After the serous membrane is opened, all the fluid is evacuated and the enlarged epididymis examined through the wound. The testicle, with its adnexa, is delivered from the tunica vaginalis and enveloped in warm towels. The epididymis is then examined and multiple punctures made through its fibrous covering with a tenotome, especially over those portions where the enlargement and thickening are greatest. The knife is carried deep enough to penetrate the thickened fibrous capsule and enter the infiltrated connective tissue. When the knife is through the thickened covering of the epididymis, a very marked lessening of resistance will be felt. If pus be seen to escape from any of the punctures, the opening is enlarged and a small probe inserted in the direction from which the pus flows. By this method, I believe there is less danger of injuring the tubes of the epididymis than by cutting with the knife. After the probe is passed in, pus will be evacuated by light massage in the region of the abscess, and a fine-pointed syringe is used to wash out the cavity with 1 to 1000 bichloride of mercury, followed

\* Acute Gonorrheal Epididymitis Treated by the Method of Bier, Boston Medical and Surgical Journal, October 28, 1909.

by physiological salt solution. The testicle is then restored to its normal position, and in every case the tunica vaginalis is thoroughly washed with 1 to 1000 bichloride, followed by normal salt solution. The incision of the tunica vaginalis is lightly closed with a running catgut suture; a cigarette drain of gauze is then laid over the incision, the skin being brought together with a subcutaneous silver-wire suture, the cigarette drain passing out at the lower angle of the wound."

This operation is to be considered only in extremely acute cases. It has not as yet been determined whether the operation increases or decreases the occurrence of sterility.

*Declining Stage.*—Various methods of hastening the resorption of the exudate have been suggested, such as strapping the testicle with adhesive plaster or with a rubber bandage. Personally I believe that just as good results are achieved by using Alexander's Bellevue bandage for a week or two after the acute inflammation has subsided. No urethral injection, or instrumentation should be used until a number of weeks have elapsed, as these may cause an acute exacerbation of the epididymitis.

*Recurrent Attacks.*—Acute gonorrheal epididymitis is not often complicated by acute recurrences. These are much more often seen in epididymitis occurring with hypertrophy of the prostate and infection of the posterior urethra and bladder. Recurrent attacks of epididymitis may be treated precisely as the original attack.

*Sterility in Bilateral Gonorrheal Epididymitis.*—In sterile marriages the fault lies with the male in over 15 per cent. of the cases, and in probably most of these there is azoöspemia due to chronic epididymitis of the globus minor, and occlusion of the ducts leading to the vas. For these cases Martin<sup>7</sup> introduced the operation of epididymovasotomy. An anastomosis is made between the vas deferens and the head of the epididymis. The testicle is exposed, together with the epididymis, and the nearby vas. A portion of the globus major is incised, from which incision spermatic fluid will ooze. This should contain motile spermatozoa. If spermatozoa are not found at the first incision, various other incisions should be made in the globus major until spermatozoa are found. The vas is incised longitudinally, and its lumen opened. The edges of this incision are sewed to the edges of the wound in the epididymis. Martin uses fine silver wire, and fine needles for the suture. Naturally such an operation is deferred until any disease of the urethra or seminal organs—strictured urethra, prostatitis, seminal vesiculitis—is cured.

It is probably better to operate upon one side first rather than on both sides simultaneously. If the operation be a success, then the second one need not be done. To ensure the patency of the vas deferens, argyrol may be injected into the cut vas at the time of operation. If the argyrol appears in the urine, the vas is patent.

### GONOCOCCAL INFECTION OF THE BLADDER AND KIDNEYS.

In spite of the frequency of gonorrhea of the male urethra gonorrheal cystitis or pyelonephritis is extremely rare. The gonorrhea seems to stop at the internal urethral orifice or the trigone. The only case of gonorrheal cystitis that I have seen was in a woman. Here the gonococci evidently reached the urethra in virulent form and the patient passed nearly pure blood for two or three days. There are probably not more than twenty cases of gonorrheal pyelonephritis\* in the literature. In symptoms it does not differ from any other pyelonephritis, and the diagnosis is made by finding gonococci in the specimen of urine obtained from the kidney.

### NON-GONORRHEAL URETHRITIS.

**Postgonorrheal Urethritis.**—A patient may have all of the symptoms of a urethritis after the gonococci have disappeared from his urethra. This is caused primarily by damage to the urethra by the gonococcus and secondary infection by some other organism (see Bacteriology). The symptoms are those of a chronic gonorrheal urethritis only the gonococcus is not present. The complications are limited to a prostatitis or seminal vesiculitis.

**Traumatic Urethritis.**—There are a great many causes for this: Instrumentation, passage of a stone, introduction of caustic injections by mistake, or with the idea of aborting a gonorrhea, crushing the penis, or bending the erect organ. Such a urethritis is often followed by permanent damage to the urethra, and stricture.

**Syphilitic Urethritis.**—The urethra may be the site of a chancre which may be entirely overlooked until the secondary syphilitic eruption appears. The only symptoms may be those of a mild urethritis, discharge, urethral burning, etc.

Secondary syphilitic inflammation of the urethra as well as of the bladder and even the kidney have been described. These are generally in the form of mucous patches.

**Herpetic, Eczematous, Diathetic, and Ingestive Urethritis.**—The first may occur in eczematous patients, with an exacerbation of an eczematous attack. Patients with gout, patients with an attack of gripe, and diabetic patients may have symptoms of urethritis, which occurs during an acute exacerbation of the disease. Alcohol, cantharides, arsenic, purgative mineral waters, iodide of potash, turpentine, asparagus, have all been accused of lighting up a mild urethral inflammation.

**Treatment.**—The treatment of all these forms of urethritis consists in removing their cause and then treating them as one would a chronic gonorrheal urethritis, giving preference to astringents. Vaccines apparently do no especial good.

\* E. MacD. Stanton<sup>11</sup> gives the bibliography of these cases in an article, "A Clinical and Histopathological Study of the Gonococcal Infection of the Kidney."

*Is a Non-gonorrheal Urethritis a Bar to Matrimony?*—This is more or less of an unsolved problem. It is reasonable to suppose that a woman may be infected by these non-gonorrheal organisms, which infection may cause vaginitis, which inflammation might possibly cause a woman to become sterile. Indeed, I have seen a case of a violent but short-lived vaginitis of this sort follow shortly after marriage. The husband had a non-gonorrheal urethritis and stricture. Most urologists believe, however, that a man with a non-gonorrheal urethritis can marry and that no trouble will follow. It seems to be the consensus of opinion that the gonococcus alone is responsible for endometritis, salpingitis, etc.

**Urethrorrhea, Prostatorrhea, Spermatorrhea.**—The causes for these conditions are various. Masturbation is always put first; undue sexual excitement is another cause assigned. Often they are postgonorrheal.

The symptoms are a mucous discharge from the urethra, either constant or only during defecation. The discharge may contain simply mucous or may contain prostatic cells or spermatozoa. Their principal importance lies in the fact that the occurrence of the discharge makes the patient think he has "lost his manhood" or is being much weakened by this sexual drain.

Keyes says that "the only cure is common sense, the only relief matrimony." Hygiene, exercise in the open, getting the patient's thoughts off his sexual apparatus, and keeping him away from a physician are all indicated.

#### BIBLIOGRAPHY.

1. Caulk: Surg., Gynec. and Obst., November, 1915.
2. Finger, Gohm, and Schlagenhauser: Arch. f. Derm. u. Syph., 1894, xxviii, 277
3. Flexner: Prostitution in Europe.
4. Henry: The Military Surgeon, May, 1912, xxx, 520.
5. Keyes: Am. Jour. Med. Sc., 1912.
6. Lowsley: Anatomy of the Human Prostate Gland, Tr. Am. Med. Assn., 1915; January, 1913.
7. Martin: University of Pennsylvania Med. Bull., March, 1902; Thera. Gaz., December, 1909.
8. McNeil: Archives of Pediatrics, September, 1913.
9. Poroz: Anatomy of the Prostate, Folia Urologica, May, 1914.
10. Schwartz and McNeil: Am. Jour. Med. Sc., May, 1911.
11. Stanton: Urolog. and Cut. Rev., November 2, 1913, i.

## CHAPTER X.

### DISEASES OF THE URETHRA IN THE FEMALE.

By A. T. OSGOOD, M.D.

#### ANATOMY OF THE FEMALE URETHRA.

THE female urethra, unlike that of the male, has a solely urinary function. In contrast with the urethra of the male, it is a short, wide channel analogous to the membranous portion of the male urethra.

This canal is a tube of approximately cylindrical shape whose length is 3.5 cm. (2.5 to 5 cm.), and whose wall is 0.5 cm. in thickness, beginning at the outlet of the bladder and extending almost vertically downward, when the woman stands erect, to the vestibule of the vagina. The diameter of the lumen of the urethra is about 8 mm. (7 to 10 mm.).

The mucous membrane of the urethra is thrown into longitudinal folds when at rest by contraction of the surrounding muscles, so that a transverse section of its lumen presents a median point from which radiating lines diverge between these folds like the spokes of a wheel—the picture presented at the extremity of a straight examining tube (urethroscope).

The epithelium of this lining mucous membrane is of the stratified squamous type, except near the bladder, where it takes on the character of the bladder mucosa, which bears transitional epithelium. In the inner third of the canal the mucosa presents<sup>5</sup> many small tubular glands, while the outer portion contains fewer, more widely scattered, and somewhat larger glands. On each side of the external urethral orifice, usually just within the canal, are found the openings of the para-urethral ducts (the largest of which are called Skene's glands). These ducts may open upon the vestibule outside of the mucous membrane of the urethra.

The mucous membrane often pouts somewhat at the external urethral meatus upon the vestibule of the vagina, forming a slight eminence. The external orifice is found in varied forms; commonly it assumes the shape of an inverted Y by reason of the prominence of a longitudinal fold upon its floor. It is seen as a vertical slit with prominent margins or as a dimple or depression in the eminence with radial folds in its lining membrane. The prominent folds of mucous membrane upon the margins of the meatus may overlie the orifice in such a way as to conceal the lumen, so that in a child or adult with small vulva and intact hymen, careful observation is needed to detect the lumen of the canal.

The submucosa is a stratum of loose areolar tissue, separating the epithelial layer from the innermost (longitudinal) muscular layer, containing elastic fibers and a network of cavernous venous spaces which form a spongy, erectile tissue. The mucous membrane with its numerous longitudinal folds is a cylinder within the cylinder comprising the muscular sheath, and is loosely connected with it by the submucosa.

Subjacent to this submucosa is a sheath or cylinder of longitudinal smooth muscle fibers, thin near the bladder and thicker near the external orifice. Outside of the longitudinal smooth muscle layer is the second layer of smooth muscle fibers which are arranged in circular or ring fashion about the tube. This circular layer is of importance, for its upper portion surrounds the beginning of the urethra at the vesical outlet to form the involuntary sphincter of the bladder, which must be considered, as Kalisher<sup>1</sup> has plainly demonstrated, not as a part of the bladder musculature, but as a urethral muscle extending into and forming a part of the smooth muscle underlying the trigone of the bladder (sphincter trigonalis, lissosphincter internus). This circular layer of smooth muscle is thick and well defined about the inner one-third of the urethra, extending obliquely about the urethra from its anterior surface downward and backward to form the muscular layer of the trigonum vesicæ. About the rest of the urethra it forms a cylindrical sheath, becoming thinner as it approaches the external urethral orifice.

These smooth muscle layers are not voluntarily controllable, and are innervated by nerve fibers from the pelvic ganglions of the sympathetic hypogastric plexus.

The third and most important of the muscle layers surrounding the urethra is the outermost striated, voluntary muscle the "sphincter urogenitalis," or compressor urethræ muscle, which is found between the two layers of the triangular ligament of the perineum.

These striated fibers surround completely only the upper portion of the urethra above the urethrovaginal septum, where bands interlace both in front of and behind the urethra to form a ring muscle. Some fibers extend upward beneath the urethra toward the bladder in a longitudinal direction. Where the urethral and vaginal walls run parallel the fibers of this muscle do not decussate below the urethra in the urethrovaginal septum, but extend downward on each side to end in the lateral aspects of the vagina. The anterior extremity of the urethra near the orifice is not surrounded by the sphincter urogenitalis muscle, *i. e.*, that part of the canal in front of the anterior layer of the triangular ligament of the perineum. The anterior layer of the triangular ligament serves to suspend and fix the urethra in the subpubic angle. This striated muscle, sphincter urogenitalis, or compressor urethræ is innervated through branches of the pudic nerve. The urethra may be divided for description into two<sup>2</sup> parts.

1. This portion extends from the bladder wall to the point where it

meets the urethrovaginal septum—the urethra libera. This portion, measuring about 1 cm. in length, is surrounded by areolar tissue which loosely fills the surrounding space between the symphysis pubis (2 cm. anterior to the urethra) and the anterior vaginal wall behind. On each side of this urethra libera the anterior (mesial) margins of the levator ani muscles pass down close to the urethra, passing the vaginal wall as well, to reach insertion in the rectal wall, median perineal tendon, and external anal sphincter.

This free portion of the female urethra is surrounded, as in a sling, by the posterior fibers of the sphincter urogenitalis or compressor urethræ muscle. Some of the fibers of this muscle run upward in a longitudinal direction upon the posterior surface of the urethra toward the bladder. This is the only part of the female urethra completely surrounded by fibers of this voluntary muscle.

This portion of the urethra surrounded by the internal involuntary sphincter muscle and these circular fibers of the compressor urethræ muscle are particularly liable to injury by pressure of the child's head during delivery, and lead to the discomforts of incontinence so commonly found in women who have borne children.

2. The second (lower) portion of the urethra is that part extending from the point where the free portion of the urethra and the vagina come into relation to form the urethrovaginal septum. This is the vaginal portion of the urethra, and measures approximately  $2\frac{1}{2}$  cm. in length. The compressor urethræ muscle extends around the anterior and lateral walls of this part of the urethra without extending into the urethrovaginal septum beneath the canal.

The course of the urethra from the bladder to the vestibule of the vagina follows a slight curve beneath the symphysis pubis, whose concavity is directed anteriorly, and the canal is separated from the symphysis about 1.5 to 2 cm. In the erect posture (standing or sitting) the course of the urethra is nearly vertical, while in the dorsal position, as during examination, it is practically horizontal, and its slight curve can be disregarded clinically.

In passing a straight instrument, such as a urethroscopic tube, it is in fact more comfortable for the patient and simpler for the surgeon if no attempt is made to follow the gentle curve. The tip of the instrument by this method impinges against the less sensitive superior wall and glides smoothly into the bladder.

The inferior (posterior) urethral wall lies upon the median line of the anterior vaginal wall, but separated from it by tissue of 0.5 or 1 cm. in thickness, which is called the urethrovaginal septum, consisting of dense connective tissue containing elastic and muscle fibers.

The internal urethral orifice is found normally at the lowest point of the bladder. The vesical trigone is less marked than in man, and the ridge called the uvula vesicæ is usually absent, so that the shape of this orifice is nearly round. It lies 2.5 cm. posterior to the lower half of the symphysis pubis.

The external urethral orifice lies in the sagittal plane of the vestibule

1 or 1.5 cm. from the lower margin of the symphysis, and at a variable distance from the vaginal margin. It presents diverse forms (sagittal cleft, star, triangular) of opening, upon a more or less well-defined papilla, commonly with a ridge upon the lower margin or floor, which produces the inverted Y-shape in many cases. This is the narrowest portion of the canal, varying in size, as does the external urethral meatus in man. Skene's ducts and a varying number of smaller para-urethral ducts open upon the margin of the external meatus usually in the sulci between the median fold upon its floor and lateral walls. These ducts are of particular importance, since they often are the lodging-place of prolonged infection, especially that produced by the gonococcus.

The blood supply of the urethral tissues arises from branches of the internal pudic, inferior vesical, and vaginal branch of the uterine arteries. Its veins pass into the vesicovaginal and prevesical or pudendal plexuses. About the upper part of the urethra (neck of bladder) the veins in the submucosa are abundant, giving rise to the darker color of the mucosa at this point.

The lymphatics of the urethra pass to nodes of the hypogastric chain and to nodes in the inguinal regions.

Sensory nerves of the urethra come from the pudic and through the sympathetic nerves of the pelvis.

### PHYSIOLOGY OF THE FEMALE URETHRA.

The female urethra is the channel of outlet for the renal secretion from the reservoir called the urinary bladder.

The ability to retain fluid in the bladder depends upon muscular closure of the tube. Paralysis of these muscles results in inability of the bladder to retain its contents—incontinence.

The urethra occupies, therefore, a most important place in the function of urination. The musculature of the bladder undertakes that part of this function which embraces the storing up of fluid by dilatation and its forcible expulsion by contraction of the detrusor.

The internal, plain muscle, involuntary sphincter of the bladder surrounds the beginning of the urethra at the vesical outlet. Versari demonstrated that this muscle is distinct from the musculature of the bladder. It is a thickened portion of the circular plain muscle layer of the urethra. It is intimately related with part of the bladder (trigone and orifice) and with part of the urethra.

Surrounding the urethra at a lower point (*i. e.*, distal to this internal sphincter) is a second sphincter of striated muscle which may be held in contraction through voluntary effort to close the canal and retain urine in the bladder, reinforcing the function of the internal sphincter.

"The chief physiological factor in the closure of the urethra, and therefore in the normal retention of urine, is the internal sphincter."<sup>2</sup> By the action of this muscle, urine is retained in the bladder of the dead

body, and in the living the tonic contraction of the internal sphincter permits the accumulation of urine in considerable amounts, with periodic evacuation.

Rehfish, Hanc, von Zeissl and others have adduced experimental evidence, which indicates that relaxation of the internal sphincter precedes the contraction of the detrusor in normal urination, and is the main factor in the process of micturition incited by desire. Lesions which induce dilatation of the internal sphincter and contraction of the detrusor can often be traced to that area within the urethra which is surrounded by the internal sphincter. Failure of the sphincters to perform their function of control of urine in the bladder (incontinence) points directly to some defect which may lie within the canal which these muscles are designed to occlude, or to failure of one or both of the sphincters themselves, to produce complete closure of the outlet.

The sensation of desire to void urine is doubtless one which arises about the bladder outlet (often, if not always, in the lumen of the urethra), and normal control consists not only in contraction of the external voluntary sphincter, but in accentuation of inhibitory impulses to the spinal centre controlling the reflex act of micturition, so that efferent impulses do not accomplish complete relaxation of the internal sphincter, even though contractions of the bladder detrusor may be so strong as to be painful.

Interruption of the act of urination can be accomplished by woman as well as by man, although in the female the voluntary sphincter is a weaker muscle and does not embrace the urethra so completely as in the male. This interruption is produced by contraction of the internal involuntary sphincter, not through voluntary control of this muscle itself, but through a check upon the reflex in the spinal cord transmitted to it from the cerebrum.

These features of the physiology of micturition are emphasized because of their important bearing upon disturbances of function and diseases of the female urethra.

The female urethra does not possess the highly sensitive structures of the prostatic urethra, yet the juxtavesical portion of the female urethra is its most sensitive part, and stimulation of its mucosa induces the desire for urination, and often (if not always) sets in action the spinal reflex of micturition.

The urethra is often overlooked or disregarded in the mechanism of urination when its importance is paramount. Every complaint of painful urination should focus the attention of the investigator upon the urethra as the seat of origin of this symptom. Abnormally frequent urination points to a disturbance of the sensory nerves ("sense of titillation") in the grasp of the internal sphincter, which induces a dilatation of this muscle and a reflex contraction of the bladder musculature.

All treatment for the relief of abnormalities of the function of urination must take into account the anatomical structure of the urethra

with the muscles which surround it and the physiological action of these structures.

The function of urination is usually ascribed by physiologists to the bladder, so that clinical application of these physiological studies leads not uncommonly to the ascribing of all changes in this function to abnormalities in the bladder itself, while the all-important urethra is forgotten.

### MEANS AND METHODS FOR EXAMINATION OF THE FEMALE URETHRA.

Preparatory to examination the patient should present herself without voiding urine and without cleansing the vulva by bath or douche for from four to six hours preceding the time of examination.

Urethral instruments must be sterilized and manipulated with all aseptic precautions. The methods for sterilization, etc., of instruments is elsewhere considered.

The preparation of the patient consists in washing the vulva with green soap and water. After covering with sterile towels the legs of the patient, and the examining table where contact with the hands of the surgeon or with instruments is possible, drape a sterile towel over the inner side of each thigh so that its inner margin falls in the median line of the vulva. By this means a margin of towel may be used to retract beneath it the labia minora and majora, exposing the vestibule and meatus urinarius.

The meatus and vestibule are then carefully washed with a solution of bichloride of mercury 1 to 2000 or other antiseptic solution.

Instruments are lubricated before insertion into the meatus with one of the numerous soluble colorless jelly-like lubricants made from certain mosses (K. Y. jelly, etc.). Glycerin is a less satisfactory lubricant and oily substances, such as olive oil, vaselin, etc., are very undesirable, chiefly because they befog a lens or electric-light bulb.

The position of the patient for this examination is important, and doubtless the best from the stand-point of the examiner is the knee-breast position, because in this position the abdominal contents fall downward and forward, relieving the bladder and entire pelvic cavity of pressure, permitting the ingress of air into the bladder and collecting the urine at the vertex instead of the base as it escapes from the ureters, thus relieving the examiner of the troublesome outflow of urine into the urethroscopic tube during examination of that part of the urethra close to the vesical outlet. This position, however, has distinct disadvantages to the patient. It is offensive to her to be thus exposed and examined, and it is uncomfortable and fatiguing after a short time. In some cases, however, it is necessary to resort to this position.

The common dorsal position, as for gynecological examination, is usually the most practicable one and the one assumed with least complaint on the part of the patient. Nine out of ten urethroscopic examinations can be satisfactorily made with this position. The dorsal

position with the pelvis elevated and the body supported by shoulder braces, simulating the Trendelenburg position, is sometimes resorted to, but offers only slight advantage.

The Sims posture is often very satisfactory, and with the foot of the table elevated may compare with the knee-breast position in favorable features. The Sims position frequently has to be used when stiffness of the hip or spine (ankylosis, old fracture, etc.) interferes with the dorsal, the knee-breast, or knee-elbow position.

**Inspection.**—The patient is placed in the usual dorsal position, with knees separated and thighs flexed, as for any gynecological examination, and the labia minora are gently separated, exposing the vestibule and vaginal orifice.

By careful inspection the urethral orifice and the vestibule may reveal excessive or abnormal secretion. For the detection especially of inflammatory changes in and about the urethra it is imperative that this inspection shall be made before any cleansing of the vulva has been done by a nurse or by the surgeon, because it is important to note whether secretion is present about the whole vulva (as with profuse vaginal discharge), whether there is secretion, swelling, or unusual redness about the meatus, the para-urethral ducts, the vulva or the vaginal outlet for the differentiation of a generalized purulent infection from an isolated lesion in or in connection with the urethra.

The first inspection should note the size, shape, and color of the meatus and of the vestibule about it as well as the presence or absence of secretion and the source of secretion. The anterior vaginal wall should be seen, when possible, to detect scars beneath the urethra or swelling projecting upon this surface.

The mouths of para-urethral ducts, usually invisible in the normal state, may sometimes be brought into view by displacing the lips of the urethra or gently pressing downward upon the median fold upon the floor of the meatus. If these ducts harbor an infection they are distinguished as red points about the size of the head of a pin. The most satisfactory means of exposing these orifices of Skene's or para-urethral ducts to view is that proposed by Kelly, using two probes bent to the shape of hairpins, or two hairpins even, which can be satisfactorily sterilized by boiling, to serve as retractors.

**Palpation.**—It should be made a practice always to palpate upon the vestibule and vaginal orifice with pressure toward the meatus before pressure is exerted upon the full extent of the urethra per vaginam since the external urethral meatus may be the seat of isolated sensitiveness or induration or the para-urethral ducts alone may be the source of a little secretion.

With the index finger in the vagina so that its pulp is in contact with the median portion of the anterior vaginal wall, pressure is exerted upon the urethra from the bladder floor to the outermost part of the canal, in an effort to express any secretion toward the meatus and to note the consistency of the urethral wall and determine points of sensitiveness.

Normally the urethral canal feels like a rounded tube when thus

palpated through the vagina. It moves slightly from side to side as it rolls beneath the finger, and no complaint of pain is made by the patient. Points of sensitiveness are often valuable signs, pointing the way to the discovery of lesions when other means of investigation are employed.

Localized indurations or dense thickening in the entire wall of the urethra with immobilization point to peri-urethral inflammation or infiltration. Localized nodes and small peri-urethral abscesses can be better defined by palpating the urethral canal per vaginam after a solid instrument, such as a sound or glass or silver catheter, has been inserted through the canal.

This instrument affords a firm body against which the urethral wall is pressed, and brings into prominence abnormal areas against the palpating finger.

**Anesthetics.**—The urethra is highly sensitive as compared with the bladder, vagina, or rectum and anus. Examination, therefore, to be satisfactorily carried out must be made with extreme gentleness and deftness. Local anesthetics are frequently employed, and general anesthesia is necessary when very painful lesions exist, yet in the majority of cases no local or general anesthesia is used for examining the urethra, or for passing catheter, cystoscope, or other instrumentation. It is better to use no anesthetic which so changes the bloodvessels by contraction or dilatation that the color of the mucous membrane is altered. Cocaine blanches an inflammatory area so that its pathological redness fades, destroying thereby an important feature. Cocaine is so surprisingly toxic to some individuals, and absorption by the urethral mucosa is so rapid that it should not be advocated. It is, however, the most certain of all our local anesthetic drugs for allaying pain.

Novocain, 4 per cent. solution or weaker, is less toxic and causes less disturbance of the natural appearance than cocaine, and, while less positively analgesic, is commonly very satisfactory. Alypin, 5 per cent. or 10 per cent. solution, is commonly used, and many others are commended.

Spinal anesthesia with tropacocain (dose 1 c.c., 5 per cent. solution) injected through the third or fourth lumbar interspace is an efficient and useful means for making an examination of the urethra, or for treatment of urethral conditions, in cases impossible to examine and treat under local anesthesia. The general anesthetics, nitrous oxide, nitrous oxide and oxygen, ether and chloroform must be resorted to as indicated.

In highly neurotic subjects or in cases with great pain the preliminary employment of morphin, morphin and atropin, or morphin and scopolamin, injected hypodermically, is useful.

The use of suppositories of opium or morphin is often advantageous.

To anesthetize the urethra with a local anesthetic, soak a small pledget of absorbent cotton with the solution and place it over the external meatus and surrounding vestibule, and, allowing the labia minora to close together over it, hold it, if need be, in place five minutes. Take up into a conical-tipped urethral syringe 2 to 4 c.c. of the same

solution and inject this slowly through the urethra, making sure that none escapes from the external meatus about the syringe tip, which should occlude this orifice. If this solution is slowly injected it distends the urethra and comes into contact with its entire surface until the sphincters relax and permit it to enter the bladder after a minute or two. This usually gives satisfactory anesthesia, and is commonly employed.

A stick applicator wound for 3 cm. from its tip with absorbent cotton and wet in the anesthetic solution may be slowly passed through the entire urethra and left in place for three minutes to produce excellent anesthesia, but it has the great disadvantage of rubbing the surface epithelium so as to produce slight abrasions, especially at the site of inflammatory lesions, ulcerations, polypi, etc., and may give rise to trouble in inspection or through persistent hemorrhage. It is to be avoided, therefore, when the urethra is the object of examination, although often useful for anesthetization of the urethra for cystoscopy.

With the insertion of the urethroscopic tube points of special sensitiveness can be anesthetized as they are encountered by withdrawing the obturator, and, holding the instrument perfectly steady, applying to the mucosa with which the obturator was in contact a swab wet with the anesthetic solution. It is sometimes necessary in this way to anesthetize the margin of the internal sphincter and the uppermost part of the urethra.

**Urethroscopy.**—*Instruments.*—To observe the mucous membrane within the urethral canal some form of speculum or urethroscope is required.

For visual examination of the urethral mucous membrane (urethroscopy) an instrument (urethroscope) is necessary which either (1) opens and holds apart the normally apposed walls so that they may be illuminated and clearly seen, or (2) one which by a prism or lens reflects light falling upon a small part of the wall and carries the picture out to the eye through a system of lenses.

Urethroscopic instruments of many varieties have been constructed and commended since Grünfeld (1881) studied the urethral mucosa through a glass-windowed tube reflecting light from a head mirror into this tube. A complete description of the many which possess merit and of their use is not here attempted.

The most simple has proved, after the use of practically every form thus far presented, to be the most serviceable. My own choice is the straight tube with a strong light thrown through it from a small electric bulb, such as the light-carrier made by H. H. Young for his straight male urethroscopic tube or by light reflected from the head-mirror. Illumination by a small electric bulb carried into the inner extremity of the tube is useful especially when the light is sheathed in a compartment separated from the examining tube (Furniss's female urethroscope). Urethroscopes which are modifications of the cystoscope with lens systems require skilful manipulation and encumbering paraphernalia entirely unnecessary for routine work of simple, rapid, painless and

adequate inspection but should be available for examination of the vesical outlet and for special cases.

The Kelly urethroscope and cystoscope is a cylindrical metal tube provided with an obturator whose end is smoothly rounded and whose ocular outer extremity is expanded in funnel shape. It is provided with a grip or handle set upon the funnel expansion and at an angle suitable for easy manipulation. Three or more of these instruments of different sizes (24, 27, 30 Charrière scale) should be at hand for use in urethrae of varied caliber. The most useful size is the No. 30 Charrière scale (10 mm. diameter), while in young girls and small women the urethra will usually admit an instrument No. 24 Charrière scale (8 mm. diameter).

Its shaft with obturator in place is lubricated and introduced through the urethra to the bladder and the obturator withdrawn permitting the escape of urine which is collected in a sterile glass or bottle for complete examination.

By means of absorbent cotton swabs on stick applicators, a dozen or more of which should be at hand, the urine in the tube and bladder floor is quickly wiped away, and, throwing the light through the tube, the bladder wall is seen and the instrument is slowly withdrawn until the internal sphincter margin falls like a fringe or curtain over the inner extremity of the tube and closes down over it like an iris diaphragm to a pin-point opening and then to closure of the bladder cavity. If the patient is in the dorsal position, urine flows into the tube rapidly, so gentleness and patience in swabbing for a moment or two is necessary to obtain a clear view of the margin of the vesical outlet to study its shape and color and to observe abnormalities. Since this is a highly sensitive portion, it is often well to insert a swab soaked in 4 per cent. novocain or other anesthetic, and to hold it for one minute so that it comes in contact with the sphincter margin. Facility and rapidity at this point render this application of anesthetic necessary rarely, and only in cases of highly sensitive lesions or markedly excitable women.

When the internal sphincter has closed over the end of the tube the outer portions of the urethra are easily kept free of fluid by the occasional wiping with dry absorbent cotton on an applicator, and, by very slowly drawing the tube outward, little by little, each and every part of the urethral wall comes into view and its characteristics are noted.

Any area upon the roof, floor or lateral walls can be inspected and treated by tilting the tube so that this part is encircled by the inner orifice of the tube. The shortness and mobility of the female urethra make this maneuver even more simple than in urethroscopy in the male.

The normal urethral mucous membrane beyond the end of the urethroscopic tube appears in the form of a flattened funnel with radial lines from the central body extending outward to the margins of the examining tube. This appearance is only obtained when the

central point (or the long axis) of the lumen of the tube corresponds with the same point of the urethra. It is fundamental that beginners should understand this and learn to hold the tube straight in the axis of the urethra and withdraw it in the same axis while inspecting. To study noteworthy areas the tube end is diverted toward them and then the proper direction of the tube must be resumed.

The radially directed lines seen in the mucosa are sulci between longitudinal folds of the mucous membrane. The sulci in the normal mucosa number about ten. If, now, we observe but three or four such sulci we realize that swelling has occurred to obliterate many sulci and large smooth rugæ or folds represent the abnormal area.

The orifices of crypts and glands in the mucosa are found here and there in the normal case often with difficulty, but when these orifices are the seat of an inflammatory process or the glands are distended with inflammatory material, then they are distinctly visible by the redness of their margins contrasting with the surrounding mucosa or a tiny fleck of white or yellow material marks them and a tumefaction in the mucosa presents itself.

In some cases a ridge or fold of normal mucous membrane is found upon the floor of the urethra running down from the trigone of the bladder (*colliculus cervicalis*). This ridge may be continuous through the length of the urethra or it is lost about 1 cm. anterior to the internal sphincter. Often a longitudinal fold is to be found upon the floor just within and extending out through the external meatus. About 1 cm. from the external meatus a definite change in the shape of the canal takes place sometimes so that it appears as a transverse slit, and 0.5 cm. within the external meatus the canal becomes a vertical cleft.

The external urethral orifice is usually the narrowest part of the canal, and while it is not so distensible or dilatable as the rest of the tube, it is usually dilatable to a considerable degree. This is an area of marked sensibility and the vestibule and urethral orifice may require the application of a swab of novocain (4 per cent.) or alopil (5 per cent.) or cocaine (5 to 10 per cent.) before a satisfactory examination can be conducted with due consideration of the patient.

When a urethroscope or other instrument is to be introduced, inspection usually suffices to decide upon the size that will comfortably pass the meatus. The most efficient examination of the entire urethral wall is made with the urethroscope which separates the folds to the greatest reasonable extent without causing pain. An instrument of small size necessitates more searching into the depths of sulci and more turning of the instrument from side to side with greater discomfort and a more prolonged observation even in the most experienced hands. A too small instrument usually gives rise to more pain than one which smoothly passes but fills the urethral tube.

When the meatus is found with diameter smaller than the rest of the urethra and dilatation is necessary, this is easily carried out by anesthetizing with novocain or other mucous membrane anesthetic on cotton

which is applied to the vestibular surface of the meatus and inserted within the orifice. Then insert a conical metal dilator and gently press it into the orifice until the requisite size has been attained. If this dilatation is slowly carried out with gentleness, no tear or bleeding will result in the usual case but a small tear of 1 or 2 mm. will occasion little or no bleeding and no subsequent pain or ill-effect.

Occasionally in multiparæ and the aged the external meatus is larger than the main channel, so that care must be exercised that no forcible dilatation within the meatus is produced by the introduction of too

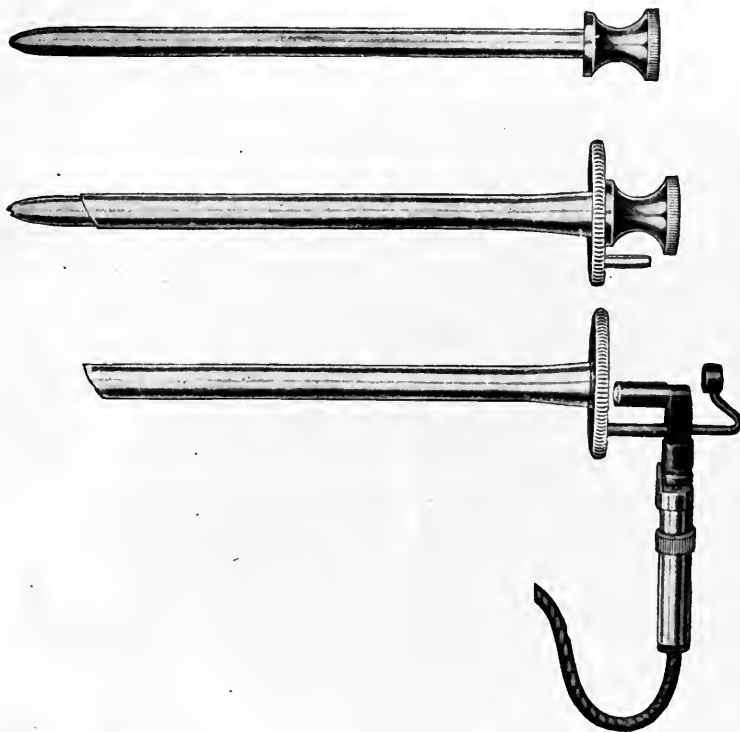


FIG. 169.—Young's urethroscope and light carrier.

large an instrument. If the meatus is fibrous and rigid, a small cut in the median line on the floor may be necessary to enlarge it after the interstitial injection of an anesthetic by means of hypodermic syringe and needle.

The best means of determining the size of the lumen of the urethra is by use of silk-elastic bougies-a-boule, so commonly employed in the male urethra for the detection of stricture. By this instrument constrictions or narrowness of caliber are appreciated with greater delicacy and its use is attended with less risk of traumatism than with any solid instrument.

Each type of urethroscope and each modification of each type has its champions. No attempt is made here to fully set forth the advantages

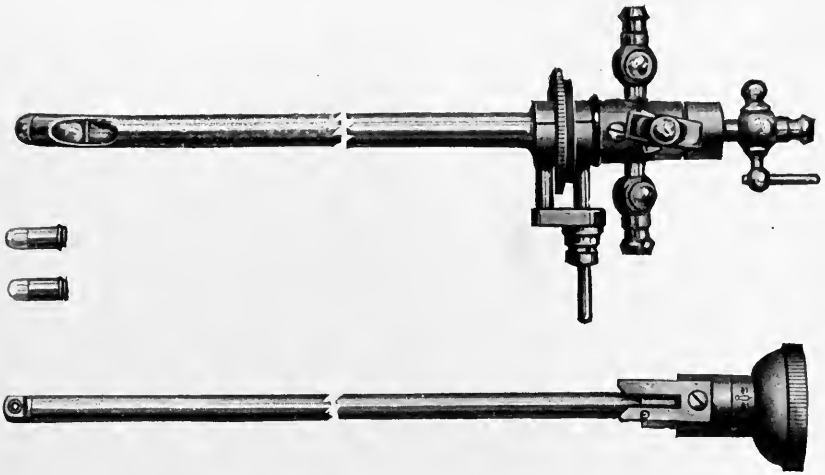


FIG. 170.—Buerger's cysto-urethroscope.

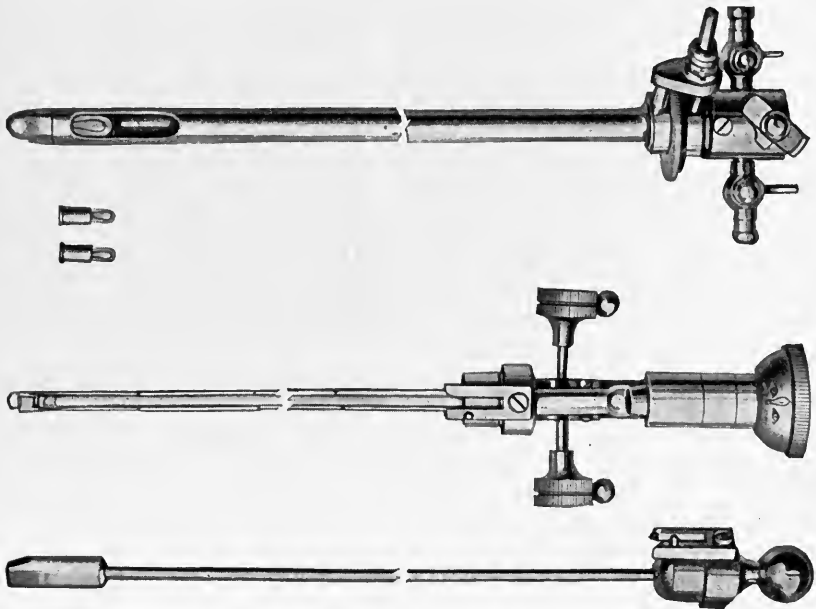


FIG. 171.—McCarthy's close vision cysto-urethroscope.

or unfavorable features of any. That the reader may be able to recognize some of the best forms, a few are represented in illustrations.

The following instruments should be at hand for every urethroscopic examination:

Urethroscopes with obturators.

Light-carrier or head-mirror.

Lubricant.

Cotton swabs on stick applicators—12+.

Urethral forceps.

Platinum loop.

Glass slides for microscopic preparations.

Evacuator.

Urethral probe or searcher.

Conical dilator or set of female sounds, graduated sizes.

Urethral syringe.

Anesthetic solution.

For Treatment.

High-frequency machine.

Silver nitrate solutions.

Urethral curette.

Urethral scissors.

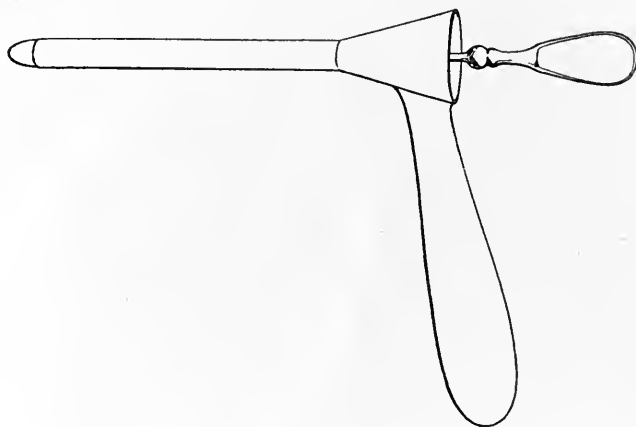


FIG. 172.—Kelly's urethroscope and cystoscope.

### MALFORMATIONS OF THE FEMALE URETHRA.

Congenital defects of the urethra in the female are rare. Hypospadias, the commonest of these errors in development, is by no means so common as in the male.

**Absence.**—Absence of the urethra has been observed rarely. In this case the bladder has opened into the vagina, or other marked developmental anomalies have been present at the same time, such as exstrophy of the bladder or patulous urachus for outlet of the urine. Atresia of the urethra, in which some parts of the wall have been formed without a patent channel, has been found in a few cases when some such anomalous opening of the urinary bladder as noted in association with absence of the urethra has been present as an associated defect.

**Malposition.**—Malposition of the urethra occurs occasionally as a congenital deformity when the urethra is usually found in a position to one side of the median line, so that the external orifice is not in the median line of the vestibule. Ordinarily in this case a second dimple-like depression is present in a corresponding position on the other side, indicating a partial formation of two urethral canals or the bifurcation of the channel. Associated with this defect have been found malformations of the vagina (double vagina) and uterus.

**Double Urethra.**—Cases of double urethra (two urethrae) have been recorded—one canal arising from a congenital bladder-diverticulum in some cases. Bifurcation or forking of the urethra, in which case the single urethral canal arises from the bladder and divides into two canals, with separate openings on the vestibule, is more common than two discrete canals. Both of these abnormalities must be differentiated from peri-urethral fistulous tracts, which are rarely congenital and sometimes the result of inflammatory processes. In many of these cases one channel serves as the urethra while the other is accessory and non-functionating. The abnormal opening of one ureter upon the vestibule or near the urethra must be distinguished from these urethral abnormalities.

**Hypospadias.**—Hypospadias in the female is a pathological rarity, for while some degree of it is found in 1 out of every 400 males, only 35 to 40 cases have been reported in the female. Hypospadias is a defective development of the external portion of the inferior urethral wall by which the external meatus appears as an oblique opening on the anterior vaginal wall. It is to be distinguished from congenital urethrovaginal fistula in which an opening in any part of the urethral floor connects with the vagina, while the urethral floor anterior to the fistula is intact. Usually a furrow of urethral mucosa upon the superior wall or roof of the urethra can be followed out to or near the normal site of the external meatus on the vestibule. Cases are recorded of this deformity ranging from slight defect near the external meatus to total absence of the lower wall of the urethra combined with congenital vesicovaginal fistula, *i. e.*, a persistent urogenital sinus. Other defects in development of the vagina or vulva have been found in association with hypospadias (large clitoris, posterior displacement of vaginal outlet, vagina opening into urethra, etc.). The malposed meatus is often, as in man, markedly constricted, producing the same train of symptoms as stricture of the urethra, and may lead to dilatation of the urethra and laxity and loss of control of the sphincters. Infection of any part of the urinary tract above a constricted hypospadiac meatus and all sequelæ of stricture may result.

**Symptoms.**—The urine may be voided naturally and no symptoms of the presence of this anomaly be evident to the subject if the meatus is well forward on the anterior vaginal wall, but the urine may flow into the vagina if the hymen be intact, and later dribble from the vaginal outlet, soiling the clothes and thighs. In hypospadias of marked degree, when the inferior wall of the urethra is deficient for the greater part of

its extent, there has usually been partial or complete incontinence of urine because of defect in the formation of the sphincters, so that urine constantly bathes the vaginal wall and macerates the skin of the vulva and thighs. Such a victim can only by the most scrupulous cleanliness avoid the all-pervading odor of decomposing urine. This distressing condition impels the patient to seek relief, and is often the adequate basis for operative repair of the defect. In some of the cases of this defect in which a very small vagina and the urethra had a common outlet (the vaginal), "*coitus intra-urethram*" had been carried on for years.

**Treatment.**—Cases of defect of the floor of the anterior portion of the urethra with sufficiently patulous orifice which give rise to no great difficulty except strict attention to cleanliness require no surgical intervention. If the orifice is constricted it may be anesthetized with cocaine or novocain and dilated to a sufficient extent or incised and the caliber maintained by occasional dilatation.

The reformation of the inferior wall by plastic operation may be accomplished by one of the methods described for the treatment of fistula.

**Epispadias.**—Epispadias is that deformity of the urethra characterized by partial or complete absence of its superior wall. In the female it is much more rare than in the male. Nové-Josserand and Cotte<sup>4</sup> collected a record of all reported cases in 1907.

Associated defects of the pelvic bones (separation of pubic bones) of the vulva, vagina, and anterior abdominal and bladder walls are often present with epispadias. The causation of this defect is unknown.

Three grades of epispadias have been recognized as follows—

1. The urethra opens just beneath the clitoris.
2. The urethra opens beneath the symphysis and above or through the divided clitoris.
3. The urethra opens behind the symphysis and is associated with separation of the pubic bones and some degree of exstrophy of the bladder with maldevelopment of the internal sphincter.

The symptoms of epispadias relate to the soiling of the pubic region by the escape of urine in this abnormal situation. In the extreme degree of epispadias there is complete incontinence, so that the victim is constantly bathed in urine.

**Treatment.**—The simple defect of the external extremity of the superior wall just below the clitoris necessitates no surgical treatment.

Cases of second degree epispadias (subpubic epispadias) with no defect of the internal sphincter of the bladder and its resulting incontinence of urine may demand cosmetic procedures to conceal the disfiguring features of the deformity. This may often be satisfactorily accomplished by plastic operation to restore the defective junction of the labia majora and minora in the median line or to reform the mons veneris and clitoris. The conditions presented in each case must determine the procedure.

Cases of second or third-degree epispadias (subpubic or retropubic), with partial or complete incontinence, present a very difficult problem with reference to the means to restore or to form a substitute for the bladder-sphincter. No satisfactory substitute for a physiological sphincter has yet been devised. Whenever possible the tissues of the sphincter should be brought together to surround a reformed urethral canal.

Epispadias combined with exstrophy of the bladder becomes a problem of bladder surgery usually necessitating elimination of the bladder and urethra with deviation of the urine from its normal course by transplantation of the ureters, nephrostomy, etc.

### INJURIES OF THE FEMALE URETHRA.

The commonest injury to the female urethra is that produced in childbirth through compression of its muscular tissue between the child's head and the symphysis or between instruments (forceps, etc.) and the symphysis. This injury usually is not evident at the time of its production, and its effects may not be apparent for months or even years. Retention of urine, necessitating catheterization after childbirth and after operations upon the uterus, appears to be due to contusion or other injury to the nerve supply of the sphincters and to the vascular, lymphatic, and muscular structures of the vesical outlet without visible or palpable lesion.

It is apparent that the severe pressure, often prolonged, to which the urethra is subjected may result in a serious contusion or even laceration of the muscular fibers and of the mucosa. The later development of a weakened area in the wall may be followed by dilatation of the canal, or by the formation of an area of chronic infiltration or even of scar formation. The injury to the circular muscular fibers, to the internal sphincter and to the external voluntary sphincter (compressor urethræ) may result in weakening their normal contractile power with resulting partial incontinence so frequently observed. This injury, then, may be reckoned as a common cause of urinary incontinence and of urethrocele.

Its result is not always to produce incontinence, but by the injury to the bloodvessels, lymphatics, nerves, and mucous membrane changes follow slowly which appear later upon examination of the urethra as abnormal chronic congestion, chronic edema or an area of defectively nourished mucous membrane which does not possess the normal resistance to infection, so that chronic ulceration, abnormal hyperplasiæ (polypi and villous excrescences), and chronic infection may result.

The injury to nerves, while undemonstrable, may reasonably account for the changes in sensibility (hypersensibility or hyposensibility), or abnormalities in muscular, vascular, or trophic control.

Many of the disturbances of the function of urination and many of the lesions of the urethra must be attributed to this common but often overlooked cause of urethral injury—puerperal trauma.

Blows upon the urethra, as in falling astride of a board or rail, have been reported, but are rare because of the well-protected position of the urethra beneath the pubic arch, covered by the soft tissues of the vulva and perineal body. Transverse rupture and severe lacerations have, however, been observed.

Fracture of the pelvis produced by falls and crushing accidents have resulted in severe lacerations of the urethra by tearing or by puncture of its wall by ends of the fragments of fractured bones.

The urethra is in rare cases injured in coitus. With imperforate hymen, coitus has been accomplished per urethram by the gradual dilatation of the repeated act until a marked enlargement of its caliber has been produced and partial incontinence has resulted.

Examination of the urethra and the bladder cavity by the finger inserted into it is an obsolete and unjustifiable procedure. The dilatation so effected is beyond the limit of safety, and has resulted in permanent injury and incontinence of urine. There are rare cases of abnormally large urethra, hypospadias, fistula, etc., in which the finger can be introduced through the canal without resistance, and in such cases this means of examination may be permissible.

Fissure or the persistent unhealed tear in the mucous membrane in which ulceration or chronic inflammation exists has been caused by forcible, rapid, and too wide dilatation of the internal sphincter or of the meatus. This injury is produced by the introduction of the finger, by too rapid dilatation with calibrator or sounds, or through the stretching necessary to extract a calculus from the bladder per urethram or from the lumen of the urethra itself.

Operative injuries are produced by intentional or unintentional incisions into its wall, resulting in fistula or stricture, or in damage to the sphincters controlling micturition. In operations upon the anterior vaginal wall, anterior colporrhaphy, cysts, and in vaginal approach to the interior of the pelvis, the urethra is sometimes damaged and the resulting scar formation may compromise its caliber.

Operations upon the urethra itself are to be kept in mind as a source of injury. Overzealous treatment can seriously impair the mucous membrane and give rise to an irritability and hyperesthesia of very rebellious character or provoke and prolong a chronic infection. Serious hemorrhage difficult to control and recurrent may result from rough and rapid dilatation, cauterization, or incision.

**Catheter-trauma.**—**Catheterization.**—The injury to the female urethra, which is a common and potent cause of those troubles often incorrectly described or referred to as postoperative cystitis or bladder irritability, is that produced by simple catheterization. The bladder in women is often infected by the passage of a catheter. When carelessly done this is common, but even every attention paid to the strictest precautions and the most detailed aseptic technic does not rid catheterization of its dangers, although, of course, the risk of infection is thus minimized.

The writer is convinced that the commonly used glass catheter is

dangerous because of the trauma which may easily be produced by the use of this rigid instrument, and such slight traumatism may be followed by infection.

The soft-rubber catheter is far preferable, because, although the urethral mucosa can easily be injured by it, there is much less likelihood of such injury in its use. Furthermore, for its use, greater accuracy in introduction is necessary, and this is an advantage, since it demands a good view of the external meatus, which offers the opportunity to expose and cleanse the vestibule and keep it unsoiled before inserting the instrument. When resistance is met it is recognized by bending of the catheter, that a point has been reached where slow and gentle pressure is called for—not the hasty push that drives the instrument into the bladder.

In some hospitals the soft-rubber catheter has been discarded for the glass because the records showed more infections with it than with the glass catheter. This can be explained to my mind because the rubber catheter is the more dangerous when improperly employed without good light, full exposure of the part, and complete asepsis. The surface of the rubber catheter holds dirt and infectious matter after touching the vagina or vulva more readily than the smooth glass, and it carries this infectious contamination into the urethra better than does the glass. If, however, the surgeon or nurse inserts the tip of the clean rubber catheter accurately into the meatus, allowing no extraneous contact with any part of the catheter, and slowly, with gentleness, guides it through the urethra, less traumatism will be caused by it than by the glass catheter, and infection of the urethra and bladder will rarely follow.

While cystitis may follow catheterization the writer is convinced that the much more common injury or ill-effect is not cystitis but a urethral trauma and urethritis. This urethral trauma or infection may readily extend to the bladder, producing cystitis; but cystitis is not ordinarily a serious matter, and will clear up promptly when the source of its infection (usually urethral or renal source) is remedied. Cases commonly called "catheterization cystitis" persist with perfectly clear urine, but with abnormally frequent urination, discomfort during and after urination, and the urethroscopic evidence of chronic non-purulent urethritis, these cases are usually promptly curable by urethral treatment only.

### **PROLAPSE OF THE FEMALE URETHRA.**

This extrusion of the mucous membrane through the external meatus may be partial (*i. e.*, part of the circumference) or complete when the entire circumference pouts through the vestibule. It is due to an abnormal redundancy of the mucosa and laxity of the areolar tissue between mucosa and muscular layers of the wall, which accounts for its appearance in little girls, or it is due to senile atrophy and retraction of the vagina and vulva in the aged. In the aged the muscular and connective tissues of the urethra apparently share in this atrophy while

the mucosa does not, for the muscular walls appear to be shorter, narrower and more fibrous and the mucosa more redundant than normal.

While the condition is most common in children and in the aged, it is occasionally observed between the fifteenth and fiftieth years as a result of prolonged labor, or of conditions which induce repeated straining in urination for a long time (vesical calculus, urethritis, urethral calculus, polyp, etc., prolonged paroxysms of coughing, etc.).

In children the condition has been brought on by constipation, whooping-cough, vesical calculus and vulvovaginitis.

Prolapse may be sudden in onset or of slow development. In the aged the development is usually very gradual.

Complete prolapse of the entire circumference is more common than the partial. Partial prolapse appears as a pedunculated tumor, protruding from the meatus, whose base is attached to some part of the wall within the canal.

The lesion appears on examination to be a tumor at the meatus, red like the normal mucosa when recent or blue when congested; later it may be fissured, ulcerated or necrotic. It is exquisitely tender, and bleeds when touched. The meatus is displaced when the bulging is greater in one part than in others but is usually easy to find with a catheter or probe. The mucosa presents in recent cases the characteristic appearance of the urethra and is continuous with the mucous membrane covering the vestibule at the meatus and with the urethral mucosa within the canal. These points are important in distinguishing this condition from prolapse of the bladder mucosa through the urethral canal or the protrusion of a prolapse of the ureteral mucosa through this channel. Caruncle, polyp, hemorrhoidal condition of veins of the urethra and very marked edema or inflammatory swelling must be carefully differentiated. Urethroscopic examination will give positive information regarding the origin of the lesion, the site of its base, the relation to the urethral wall and the condition of the wall above the tumor.

The subjective symptoms usually complained of are the presence of a tender and readily bleeding area at the external meatus, a sense of burning pain during urination with the feeling that there is some foreign substance in the canal and a desire to expel it by urination.

**Treatment.**—Prolapse of acute onset has been observed to retract without treatment and give no further sign of its presence. Prolapse has also been relieved without recurrence by manual reduction through pressure with the fingers to replace the extruded mucosa.

Stöckel advises, in young children, the treatment employed years ago by Fritsch, which consists in passing a silk catheter to the bladder, passing a sling of strong silk ligature over the prolapse close to the external meatus and tying this down upon the circumference of the silk catheter. He says that the protruded tissue becomes desiccated and falls off, so that the catheter may be removed in three days, complete healing without serious infection follows rapidly and no general anesthetic has

been necessary. In children as well as adults and the aged the total excision of the redundant portion and suture of the margin of the mucosa by interrupted fine catgut sutures around the meatus is preferable.

Retraction of the mucosa within the canal during resection is prevented by grasping its edge with forceps as it is divided or by placing sutures before severing it.

Israel recommended cutting radial lines into the prolapse with the cautery knife. This as well as astringent and caustic applications may have served in certain cases but excision and suture is the best procedure. A partial prolapse in aged women has been treated successfully by deep radial cauterization with the high-frequency spark, but this treatment is prolonged and attended with bleeding and necrosis which for a time presents an unfavorable condition. It is not to be recommended, although it may accomplish the desired result.

Under local anesthesia combined with interstitial injection of a weak solution of the anesthetic the operation of excision can be done in short order.

### CALCULUS OF THE FEMALE URETHRA.

Urethral calculus in the female is rare as compared with this condition in the male. Like prostatic calculus in the male, calculi may originate<sup>7</sup> in the tubular glands of the female urethra, leading to the formation of a pocket about them. Calcareous deposit may take place in a pouch or diverticulum connected with the lumen of the urethra by a small or large orifice. Most calculi found in the urethra, however, are of renal and vesical origin and have been arrested in the canal in the course of their descent. Vesical calculi sometimes present prolongations into the urethra. Foreign bodies inserted into the urethra (hairpins, parts of darning needle, etc.) have been caught in the canal and served as a nucleus for the deposit of urinary salts.

Since the external meatus is usually narrower than the rest of the channel a calculus is commonly found by inspection, palpation or instrumental examination at this point.

Usually inflammation is set up in the tissues in contact with a calculus producing a purulent urethral discharge and pyuria.

**Symptoms.**—Calculus may lie in a sacculation connected with the urethra or in the canal close to the external meatus without causing noteworthy symptoms.

A calculus or any foreign body in the urethra creates greater or less disturbance of normal urination—painful and abnormally frequent urination with a constant desire to urinate and with a discharge of mucus and pus from the canal and perhaps pus and blood in the urine.

**Diagnosis.**—If a calculus is not visible at the urethral outlet, its presence can usually be determined by palpation of the urethra through the vaginal wall when an abnormal, tender, hard mass suggests its presence. With a finger in the vagina, a metal or glass catheter or other instrument may be easily brought into contact with it in the urethra.

Calculus in a diverticulum having a small communicating opening into the urethra may not give the grating characteristic of contact between calculus and the instrument, but the examiner is able to determine the position of the dense mass felt through the vaginal wall when the urethral instrument is inserted as a guide.

If a calculus is firmly held by the urethra itself or by means of the finger, a urethroscope may be inserted to view it and to aid in its removal.

X-ray examination will show the presence of most calculi in the urethra but the necessity for this means for diagnosis rarely arises.

**Treatment.**—When a calculus is suspected by the examiner, he should make sure that it does not escape him by being pressed or pushed back into the bladder. This is done by pressure upon the canal behind the calculus, closing that avenue of escape and holding it while an instrument is being passed or the meatus dilated.

If the external meatus is narrow, it may be useful to dilate or incise it under local anesthesia. By simple pressure from behind some calculi and foreign bodies may be extruded which cannot be passed naturally.

Calculi may be grasped and delivered by urethral forceps, by a curette or bent probe or sling of wire which has been used to reach behind a calculus and pull it forward.

Calculi have been removed from the urethra with the aid of a large urethroscopic tube through which one could see and accurately grasp in forceps a calculus which defied removal without the aid of the tube.

Calculus material in a pouch or diverticulum calls for treatment of the diverticulum primarily for such a pouch will soon be refilled with deposit if the pocket is left after removal of its contents. (See Treatment of Diverticulum.)

Calculus may be intentionally pushed backward into the bladder where it may be crushed by a lithotrite and its débris washed out or it may be grasped by suitable forceps inserted into the bladder under the guidance of cystoscopic observation and so delivered through the cystoscope or through the urethra.

The urethral portion of a vesical calculus is to be removed with the vesical calculus by litholopaxy or by operation upon the bladder.

After calculus has been removed from the urethra an examination of the bladder by means of the cystoscope should be made for the discovery of other calculi lying ready to follow the first and in the majority of cases a complete examination of the entire urinary tract (kidneys, ureters and bladder) by the means elsewhere described for the detection of calculus is indicated.

## NEOPLASMS OF THE FEMALE URETHRA.

The neoplastic structures originating in the tissues of the urethra commonly observed are those confined to the mucous membrane and its bloodvessels and usually benign in character, namely, papilloma,

polyp, cyst, and angioma. Other benign tumors arise from the connective tissue (fibroma) or muscular tissue (myoma) or from both (fibromyoma), but these are comparatively rare.

Malignant tumors primary in the tissues of the urethra are very rare but of great significance because of the gravity of the condition, the importance of early recognition of their nature and the necessity for prompt and radical removal. The malignant neoplasm most commonly found is carcinoma originating in the mucous membrane. Sarcoma is very rare.

**Caruncle.**—The frequently observed raspberry-like tumor at or just within the external meatus in women is known by the name caruncle. This term does not distinguish a particular type of tumor, histologically considered, from others of the same gross appearance found in this situation. This tumor is found at all ages but is most common after thirty years of age.

**Pathology.**—Clinically, every small raspberry-like tumor about the external meatus is called a caruncle unless it reveals growth, invasion of underlying tissue or ulceration when cancer should be suspected. Cancerous tissue may exist in such a tumor at the external meatus of a woman, without growth, extension or ulceration. Only upon histological examination of the excised tissue can the benign and cancerous conditions be differentiated. Young, of Boston, has made a careful study of 19 tumors removed under the clinical diagnosis of caruncle at the Massachusetts General Hospital during the last twenty years. He found 5 of them to contain tissue of definite carcinomatous characteristics. This is a surprisingly large proportion of malignancy in neoplasms of the urethra, for the opinion prevails that primary carcinoma of the urethra, and vestibule is exceedingly rare.

Neuberger,<sup>3</sup> in a pathological study of caruncle, described three varieties: (1) granuloma (not a neoplasm but a raspberry-like tumor found about the external meatus of women due to chronic inflammation); (2) papillary angioma; (3) telangiectatic, non-papillary mucous polyp. Caruncle may be said to be any tumor found at the external meatus of the female consisting of vascular polypoid, papillary or granular tissue.

It is convenient to group these tumors under such a term, for neoplasms of every variety found at this point give rise to about the same symptoms and require the same radical treatment. All have the vicious tendency to recur; all are highly vascular, are usually sensitive, bleed upon being disturbed by touch or as a result of dilatation and contraction of the canal in urination; all produce a sense of burning during urination; all increase in size, either slowly or rapidly; all should be regarded as potentially malignant.

**Symptoms.**—Caruncle may lead to such distress through pain, painful and frequent urination, hemorrhage, etc., that the patient may become bed-ridden and loses flesh and strength. Neurasthenia or melancholia may supervene. Caruncle may exist without giving rise

to subjective symptoms of any kind. Young reports 35 per cent. symptomless.

**Treatment.**—The thorough excision of caruncular tumors has been the accepted treatment, and promises certain success. Care must be exercised in the excision and closure of the wound to leave cicatrices which will not later constrict the urethra or meatus.

Complete wide excision of caruncle is for so small a tumor often a troublesome, bloody, and perhaps unnecessarily destructive attack upon the urethral orifice.

Angioma, papilloma, polyp, granuloma, and small tumors presenting the mixed characters of these neoplasms found in other parts of the body have been as successfully destroyed by the Oudin high-frequency current as by excision with the knife. This form of electric cauterization has been extensively used in the destruction of caruncle, and is our most satisfactory means of treatment.

By excision the specimen may be obtained for pathological study and the nature of the growth determined, whereas unless a part of the tumor with its base is excised beforehand, the destruction of the tumor by cauterization (Oudin, cautery, galvanocautery, etc.), as well as x-ray or radium treatment, eliminates the possibility of histological examination.

*Oudin Spark; Method of Application.*—After thorough anesthetization of the mucous surface by the application of cotton wet with novocain or cocaine, and the interstitial injection of the same anesthetic beneath the tumor through a hypodermic needle, the wire (electrode) is inserted into the little mass and the current turned on for 15 to 30 seconds at a time. The application is made at three or four points in the tumor. Two or three applications of this treatment usually suffice.

*Cautery; Method of Application.*—For the use of the actual cautery general anesthesia is necessary. The flat, thin cautery blade is best and should be used to sear furrows deep into the base of the tumor from each side. The furrows should meet in the median line of the urethral floor above the tumor and extend downward and inward to meet beneath its base, cutting out a half-cone-shaped piece of tissue which includes the caruncle. The application of the dull red cautery to the surface of the tumor itself often effects its complete destruction, but healing is sluggish and much pain may ensue.

*Galvanocautery; Method of Application.*—With local and interstitial anesthesia, or with general anesthesia, the galvanocautery needle is inserted into the base of the mass at several points for about one-half minute each. Healing takes place by granulation after necrosis of the tumor.

Cauterization by means of chemicals (nitric acid, trichloroacetic acid, etc.), while efficiently destructive of the tumor in some instances, presents disadvantages which have led to the abandonment of this method in favor of electric or thermal cauterization or operation.

Fibrous and smooth-muscle tumors (fibroma, myoma, and fibromyoma) develop rarely in the tissues of the urethral wall but appear as

protrusions usually upon the anterior vaginal wall, where they can be felt especially when a solid instrument has been passed into the urethral canal. Such a neoplasm may constrict the lumen of the urethra and give rise to symptoms like those of stricture. It may grow to such a size as to protrude from the vaginal outlet and interfere with coitus. The overlying mucosa of the urethra may present chronic congestion and edema with or without infection or ulceration.

Very small fibromata or myomata may call for no treatment. Large tumors or those giving rise to symptoms should be dissected out through an incision of the anterior vaginal wall without opening, if possible, the mucous canal of the urethra.

**Cysts.**—Cysts of the urethral mucous membrane of minute size are frequently observed in urethroscopic examinations. Many of these are innocent tumors calling for no interference. Some, however, occasion symptoms of irritation like that of a foreign body or of partial occlusion of the channel, and under these circumstances they must be destroyed. Cysts are usually destroyed by thorough cauterization with the high-frequency spark (Oudin) after the application by swab of a strong local anesthetic through a urethroscope.

Clipping them off at the base with urethral scissors sometimes succeeds, but is likely to be followed by recurrence because the amputation is not complete, and troublesome bleeding may follow. Simple puncture or splitting with a small knife is in some instances adequate.

**Papilloma. Polyp.**—Hypertrophied projections from the surface of the mucosa in the form of papilloma or polyp are very commonly observed in all parts of the urethra, but are especially to be found about the internal meatus on the margin of or just outside the internal sphincter. These growths are also frequently found near the external meatus. They may attain such size or be in such number as to choke the lumen, giving rise to the same symptoms as stricture.

**Etiology.**—Their etiology is obscure. In some, but by no means in the majority of cases, a history of a preceding urethritis is obtained or the evidence of chronic urethritis is revealed by urethroscopic examination. In many of the cases personally observed there has been found a mild chronic inflammation in the mucosa about them, but whether this is to be regarded as the cause of the hypertrophic growth or the growth has induced the irritation which has led to inflammation of the tissue, has been impossible to determine.

These outgrowths, even though very small, occupy an important place in diseases of the female urethra, for they give rise to exceedingly distressing symptoms and are often difficult to detect.

**Symptoms.**—Those developing at the internal sphincter especially produce aggravated symptoms such as vesical tenesmus, painful, difficult and very frequent urination, hematuria, often marked. They may escape the experienced examiner who employs both cystoscope and urethroscope to find them.

One or many of these papillary growths may be present and give no symptoms such as detailed above. When, however, one or more of

them is grasped by the internal sphincter, the most intense irritability is aroused and bleeding may be quite profuse. The blood may escape into the bladder or into the urethra or both. Terminal hematuria (*i. e.*, blood in the last portion or the last drops of urine passed) is common. Such symptoms may disappear after a few moments or hours or they may be persistent for weeks or months. A notable symptom usually is the exquisite sensitiveness of that part of the urethra in which the little villus is found, so that the passage of a catheter or other instrument calls forth a cry or start as this area is touched, and in many cases no cystoscopic or urethroscopic examination can be carried out without generous application of cocaine to this part. Patients are seen with whom general anesthesia (gas and oxygen) and complete relaxation (ether) is required to accomplish the examination properly.

These little tumors do not stand up for inspection as they are depicted in illustrations, but lie flat against the wall, often concealed in a furrow or fold of the mucous membrane, so that diligent search with the cystoscope or urethroscope is necessary.

For those at the vesical outlet the most satisfactory means of discovery consists in the use of a close-vision cystoscope (Buerger's cysto-urethroscope or McCarthy's close-vision cystoscope or similar instrument) with the light and lens on the margin between bladder and urethra, while fluid is injected through the instrument into the bladder. By revolving the instrument, examining all about the sphincter's margin while the fluid washes through the instrument into the urethra, the little villi are spread out and fall back toward the bladder and come into view. In some cases of obscure hematuria this plan has revealed a little papillary shred of mucosa pouring out its blood.

The straight urethroscopic tube (Kelly) will serve to discover many of these tumors and through it they are accessible to treatment, but in many cases its use fails to bring them into view at the sphincteric margin.

They can sometimes be well shown by means of instruments which employ air distention. The ordinary examining cystoscope often shows the projection of these tumors into the bladder. The same excrescences are found about the bladder surface of the vesical outlet and may form a fringe all about its circumference. They do not always give rise to symptoms or call for treatment. When they do fall into the urethra from the bladder, or arise in the urethra, they are likely to be real trouble-makers. Destruction of them is demanded.

In the urethral canal itself these papillary outgrowths are found by the urethroscope only and here the straight tube must be used to stretch out and illuminate all parts of the wall especially where deep folds are seen. A full-sized tube stretches the wall so that during slow withdrawal any projection from the wall falls into full view over the inner open extremity where it may be moved about by a probe or applicator, examined in different aspects and subjected to treatment. Sometimes many of these papillomata are to be found in the urethra.

When one or more project from the external meatus they are readily found on lifting aside the labia minora.

These tumors are delicate wisps of tissue often but they may contain some connective tissue and possess considerable body. Their bases may hold firmly to the surrounding mucosa, as attempts to remove them by avulsion proves through producing quite a tear running out from the base. They carry a single-looped bloodvessel or are highly vascular with many vessels large in proportion to the size of the growth. They may recur after removal particularly when the base is not treated by caustic or cautery.

**Treatment.**—Rarely the simplest form of treatment, such as the application of a weak solution of silver nitrate (instillation) or crushing by forceps or amputation with scissors, will completely cure the patient. Incomplete destruction of the whole growth, however, is prone to lead to recurrence in a short time.

The best means at our disposal for the treatment of this lesion is the high-frequency spark (Oudin current). The wire electrode is passed into the base of the growth and the current is passed into it for a few flashes or for fifteen seconds, and the growth destroyed with small likelihood of recurrence.

Amputation of the tumor at its base by means of little urethroscopic scissors with the application of the silver nitrate stick or cautery to the base is effectual, but after cutting the tissue, blood often obscures the base and interferes with the application and effectiveness of the silver nitrate.

The use of the silver nitrate stick or strong solution applied to these papillary growths will not infrequently effect their removal. Several applications are often necessary. This is painful and by no means so certain as cauterization by the Oudin spark.

Cauterization with electric or other (actual) cautery is equally as effective as the Oudin spark but it is not so completely controlled; its effect is deeper and less defined.

**Malignant Neoplasms of the Female Urethra.**—Cancer of the urethra is very uncommon, although Young, of Boston, in a recent communication reports that many of the small tumors, clinically considered caruncle, which had been removed and preserved at the Massachusetts General Hospital Laboratory presented definite evidence of malignant growth to be classified only as cancer.

Primary carcinoma of the urethra arising from its mucous membrane itself, apart from the view presented by Young (and referred to under the subject of Caruncle), is throughout the literature very rare; probably not more than 25 to 30 critically studied cases have been recorded.

Carcinomatous involvement of the urethra by the extension of a tumor from neighboring tissues has been reported in numerous cases. Carcinoma which originates in the para-urethral ducts, in peri-urethral tissues in the vestibule, labia, clitoris, vagina or bladder may make its way into the urethral tissues.

Sarcoma is still more of a curiosity than carcinoma in connection with the urethra.

Since these forms of neoplasia may be found in, or connected with, the urethra, it behooves the examiner to be on his guard for their recognition and for early thorough eradication of them when found.

Any rapidly progressing neoplastic tissue or tumor which tends to destroy, through ulceration, the neighboring tissue, which gives rise to pain, great tenderness and to recurrent hemorrhage (while it may be called a caruncle) should be under suspicion, as a malignant growth and at least a part should be removed with a section of its base for critical pathological study and diagnosis of its nature. Wide excision of the entire tumor as soon as malignant characteristics are recognized is the safer course whatever the subsequent report upon its histology may prove.

We have as yet had insufficient time since the introduction of the Roentgen rays, radium and the high-frequency spark into therapeutics to draw hard-and-fast lines in the critical judgment of the final effectiveness of these means in the treatment of cancer and sarcoma. Yet in the light of our present knowledge and the experience gained through the treatment of small superficial skin cancer, x-ray cancer, vesical neoplasms, rodent ulcer, cancer of the lip, eye, etc., we can under unusual circumstances commend these means for the destruction of very small malignant neoplasms. These agents present advantages in that the tissue is not squeezed or handled; already invaded lymphatics and vessels are not traumatized or cut across, as with the knife, leaving invisible remnants in the freshened medium of healthy tissue for further propagation; the resulting scar is smaller and complete destruction with proper technic is attainable in some cases. The disadvantages of radium, the Roentgen rays and even of the high-frequency spark are that the "dosage" has not been determined, stimulation instead of retardation or destruction may be the startling effect, and defining the action to the neoplastic tissue is not possible.

Every malignant neoplasm removable by excision should not be tampered with by these uncertain agents. Wide and thorough excision of malignant neoplasms in or connected with the urethra offers the greatest security for eradication.

Large or inaccessible growths must be excised by circumscribing incision carried out in normal tissue and, under the conditions found in each case, as much of the natural channel preserved as possible with immediate or secondary plastic repair. The meatus should be left as a broad, deep opening. The vaginal and urethral mucous linings should be sutured in apposition where the vaginal portion of the urethra has been amputated. The internal sphincter should be left intact if possible. Vesicovaginal or suprapubic drainage should be provided during the healing process in many cases to prevent infection and sloughing after urethral suture.

When the entire urethra must be sacrificed the problem becomes

one of bladder surgery with permanent suprapubic drainage, vesico-vaginal fistula, transplantation of the ureters, nephrostomy, or other provision for urinary outflow.

### STRICTURE OF THE FEMALE URETHRA.

The female urethral mucous membrane presents a lining layer composed of squamous epithelium. Columnar epithelium is present in the relatively few ducts and glands and it is analogous anatomically to the membranous urethra in the male. Stricture of the membranous urethra in the male is exceedingly rare because of the resistance to infection offered by squamous epithelium and the absence of glandular structures in or continuous with its mucosa; and so it is in the female urethra.

Gonorrheal ulceration of the female urethra, the forerunner of stricture, has not been observed and Stöckel<sup>6</sup> states that "deeply penetrating ulcerations of the mucous membrane with veritable loss of substance which cicatrize to form stricture do not occur in gonorrhea of women which has been properly treated or not treated at all," and he considers such ulcerations due, when found during or after gonorrhea, to improper treatment with caustics.

The causes of stricture in the female are peri-urethral abscess, often gonorrheal in origin, injury of the urethra in childbirth by the child's head or by obstetrical instruments, other injuries of the urethra which are followed by the formation of a cicatrix, and healed ulcerations of tuberculous or syphilitic nature.

Constrictions of the urethral lumen due to a cicatrix in the underlying vaginal wall, to abscess or tumor in the urethra or neighboring tissues are not considered here. Stricture is an acquired narrowing of the lumen of the canal through the formation and contraction of a cicatrix which results from healing of a laceration, a rupture or a destructive, ulcerative process extending through the mucous membrane of the urethra into its submucosa. This cicatricial tissue is found at one point of the circumference, in a segment or occupying the entire circumference (annular), and it may extend to greater or less extent along the canal in a longitudinal direction. Stricture of the female urethra is usually single, although multiple strictures may be found.

Constriction of the lumen and firm fibrous infiltration of the entire urethra is occasionally observed in the aged. Its etiology is obscure.

**Symptoms.**—Stricture may present no subjective symptoms for a long period but may be discovered upon the occasion of some necessary instrumentation of the urethra by the surgeon or nurse (catheterization, cystoscopy, etc.).

The subjective symptoms develop gradually and may be present for months or even years before the patient calls them to the attention of the surgeon.

The column of urine expelled through the canal becomes gradually

smaller, requiring a longer time for evacuation of the bladder and calling forth contraction of the abdominal muscles during inspiration to increase intra-abdominal pressure to aid in expelling the urine. Dribbling after the act of micturition has been completed is common as well as interruption of the flow during the act.

Infection in the mucosa of the urethra behind the stricture extending into the bladder (cystitis) with pyuria are inevitable late results.

Kolischer has called attention to ulceration of the mucous membrane behind the stricture, dilatation of this part of the canal, congestion and edema of the region of the internal sphincter, inflammation of the bladder wall especially about the vesical outlet and trigone and hypertrophy of the bladder musculature with increased trabeculation.

**Diagnosis.**—The history of one or more of the causative factors: of difficulty in urination of gradual development, of straining during the act, of interruption of the flow and of the annoying after-dribbling lead to an examination. A stricture in the female may be impassable with any instrument—impermeable stricture.

The urethroscope will demonstrate the smooth cicatricial tissue and its pale color and the coarctation of lumen. It may be possible to find the channel through the stricture by searching for it with urethroscope and probe or filiform. This examination should always be resorted to before concluding that the urethra is impermeable to instruments and applying the treatment demanded by the condition.

**Treatment.**—Gradual dilatation by solid instruments of larger and larger size until the normal caliber is reached and maintained is the best plan when feasible.

All undue traumatism and pain should be avoided through gentleness, very slow progress and the use of local anesthetics. Dilatation such as to produce bleeding should be guarded against in this treatment.

The time required in treatment for the restoration to normal caliber and maintenance of this dilatation varies greatly but no patient should be considered cured who has been under observation for less than two years, and a longer time may be requisite.

**Internal Urethrotomy.**—This procedure is indicated in cases which resist gradual dilatation, so that progress is not observed or is very slow, in cases which require immediate relief because of the infection in the urethra or bladder behind it, when catheterization must be facilitated or cystoscopic examination is demanded, and when the patient refuses to undergo the prolonged but preferable gradual dilatation.

No case in which internal urethrotomy is done escapes the necessity for gradual dilatation. The passage of solid instruments should always succeed any operative procedure to assure the patency of the canal. After internal urethrotomy, which provides an immediate enlargement of the caliber, the recontraction may be rapid unless the lumen is maintained by the repeated passage of solid instruments.

Internal urethrotomy in the female is carried out in the same way as in the male. A filiform is passed through the stricture to which a straight shaft of a Maisonneuve urethrotome is attached. When

this has been passed through the stricture, the knife of proper size is passed through its groove, cutting the stricture upon the floor and later upon the roof (upper wall). The canal should be cut to admit a sound of 28 or 30 French size.

Bleeding may be excessive as a result of this procedure, so that a cautery knife operated through an urethroscopic tube is preferred by many.

*External Urethrotomy.*—In the female this should consist in complete exposure of the stricture by incision through the anterior vaginal wall, excision of the fibrous tissue followed by end-to-end suture of the proximal and distal ends of the tube. Longitudinal incision with excision of the fibrous tissue in V-shape, leaving intact the mucosa on the roof of the canal, and then lateral suture of the longitudinal incision (as in simple pyloroplasty) is a satisfactory method.

External urethrotomy should always be accompanied by drainage of the bladder by a small rubber tube or catheter passing through a puncture or buttonhole opening into the bladder floor through the anterior vaginal wall.

This drainage should be maintained for about ten days to assure healing of the sutured urethra before the urethra is permitted to resume its function.

#### **DIVERTICULUM OF THE FEMALE URETHRA.—URETHROCELE.**

Diverticulum or urethrocele is a pouch formed by dilatation of a circumscribed portion of the inferior wall of the urethra.

Its cause is ascribed to an injury of this wall in childbirth or to the destruction of the sustaining muscular structures of its wall by an inflammatory process or by a foreign body such as calculus.

It occurs most commonly in women who have borne several children and in whom repeated traumatism to the vaginal wall and the subjacent musculature of the urethra have contused these tissues. Less common are the cases due to weakening of the wall from peri-urethral inflammation.

A pocket beneath the urethra formed by the rupture of an abscess into this canal is simply a chronic abscess cavity and is to be distinguished from true urethrocele which forms by bulging of the mucous membrane downward like an acquired hernial sac into a weak spot in its outer wall. The condition has not been found attributable to congenital maldevelopment.

Such a pouch in a multipara may exist and gradually increase in size without being recognized for a long period if no infection of its mucous lining occurs and urinary salts are not deposited in the cavity. Pouches connecting with the urethra which are the result of abscess formation usually persist as chronic abscess cavities and are especially prone to hold a calcareous deposit of urine sediment.

Those reported have varied in size but have commonly been found as tumefactions presenting upon the anterior vaginal wall 1 or 2 cm. in

diameter. If the connection between the diverticulum and the urethra is large, pressure upon its vaginal aspect gives the sense of a lax-walled cyst and its contents, expressed into the urethra, appear at the external meatus. If, on the other hand, the urethral opening is small or occluded by calcareous material, the tumor feels tense or hard.

An instrument (catheter, small sound, or probe) may be inserted along the floor of the urethra into the sacculation and felt therein by the finger in the vagina. By examining the urethral floor with the urethroscope its opening into the urethra and sometimes the wall of the cavity can be explored.

Cysts of the vaginal wall never communicate with the urethra.

Calculus retained in the urethra tends to form a bulging dilatation of the wall or pocket with ulceration of the mucosa.

Cystocele is more voluminous and not a circumscribed tumor on the vaginal wall but a protrusion carrying the vaginal wall with it.

**Symptoms.**—Painful and abnormally frequent urination, pyuria, hematuria in some cases, a tender area on the anterior vaginal wall, and a urethral purulent discharge are the evidences of the condition. The patient may report relief gained through pressure upon the tender area in the vagina which empties the sac.

The examiner by inspecting the anterior vaginal wall and palpating the tender tumor found there expresses its contents which flow out of the external meatus. He may feel through the urethrovaginal septum an instrument passed per urethram into the sac. Urethroscopy reveals the abnormal extent of the floor of the urethra or gives a view of the interior of the pouch through a narrow opening into which a probe passes.

**Treatment.**—Infection of the lining membrane of diverticulum is the rule, so that healing after removal and suture is problematic. The possibility of a resulting urethrovaginal fistula and its subsequent treatment must be kept in mind.

The ideal method of treatment of urethrocele is the total excision of the entire sac through a vaginal incision under local and interstitial or general anesthesia. With a sound or silver catheter in the urethra an incision is made through the vaginal wall into the sac of the diverticulum, bisecting it. Each half is then dissected out and the mucous membrane of the urethra cut through along the margins of the diverticulum. This wound may be closed by interrupted sutures from side to side, passing through all tissues of the bed of the sac from the vaginal mucosa to the submucosa of the urethra.

The excision of an elliptical area of the vaginal wall and urethrovaginal septum shelving inward to the urethral canal may be advantageous in some cases.

Simple incision of the sac and packing of the wound which heals by granulation has resulted favorably, but often requires subsequent closure of the fistula. Incision and cauterization of the wall with packing of the wound has likewise succeeded.

**INFLAMMATIONS OF THE FEMALE URETHRA.**

Infection of the urethra of the female is a condition the importance and frequency of occurrence of which is not sufficiently impressed upon the medical profession today. Some of the reasons for this ignorance are to be found in the total absence of this subject in undergraduate instruction of many of our medical schools and the brief and inadequate treatment of it in text-books as well as the inexperience of gynecologists and the medical profession as a whole in the careful study and localization of lesions in the urinary tract. Many surgeons make frequent use of the cystoscope but rarely, if ever, employ the urethroscope. Urethroscopy is a more difficult procedure than cystoscopy, demanding patience, skill and experience, and offers the only means for positive determination of most of the lesions and diseases of the urethra.

Acute, generalized purulent urethritis in the female is usually due to infection with the diplococcus of Neisser (gonococcus).

The diagnosis of one variety of acute urethritis from another depends upon the demonstration of the bacterial growth found in the exudate. No case of acute urethritis can be called gonorrheal until positive and authoritative demonstration of the gonococcus has been made in the exudate. It is unscientific and morally wrong to fail to prove by the best bacteriological evidence the character of the germ present in any case of urethritis. No case of acute urethritis can be diagnosticated without bacteriological study.

**Acute Simple (Non-gonococcic) Urethritis.**—Acute purulent inflammation of the entire urethra due to infection by other organisms than the gonococcus is seen in prolonged irritation of the mucosa by a catheter retained through the canal for drainage of the bladder and in the presence of other foreign bodies (calculus, inserted objects such as pins, hairpins, etc.) and after repeated traumatism or irritations, such as the frequent use of the catheter or overzealous exploration and treatment.

Infection of the urethra by unclean, rough, or frequently repeated catheterization is, in my opinion, very frequently the condition commonly and improperly called cystitis. This does not imply that infection of the bladder (cystitis) is uncommon through catheter infection but it does imply that the bladder is carelessly regarded as the seat of an inflammation or lesion which can be shown to lie in the urethra in many cases. In many of such cases the cystoscope shows normal conditions within the bladder.

Acute inflammation of the urethra of non-gonococcic origin is a condition of far greater consequence than is usually accorded to it because of the rapid disappearance of all gross manifestations of its presence through simply removing the cause of its inception (*i. e.*, removal of foreign body, cessation of catheterization, etc.) and the improvement in the subjective symptoms. This form of urethritis is regarded as of little consequence just because these signs and symptoms can so readily be

explained and so obviously and promptly relieved. Complete cure, however, does not always follow this manifest improvement. In the majority of cases, to be sure, there is no persistence or recurrence of symptoms or signs and a cure does take place. In many cases, on the other hand (and every surgeon can recall such), there is a persistence of the subjective complaints or a recurrence of them after a time. The urine then may present no pathological elements, complete examination of the urinary tract (excepting the urethra) shows no renal, ureteral or vesical abnormality and gynecological examination affords no evidence of the cause. When an examination of the urethra is made, the lesions of chronic urethritis are revealed and the history of catheter infection (cystitis?) is recalled.

An acute inflammation of the urethra often accompanied with involvement of the contiguous bladder mucous membrane (cysto-urethritis, trigonitis, cervico-urethritis so called) is a common condition the etiology of which is obscure. Among the laity this is the well-recognized "cold in the bladder." Exposure to cold, errors in diet, highly acid urine, alcoholic excess, chemical alteration of the urine other than abnormal acidity due to obscure metabolic processes have all been put forward in explanation of the cause of this condition.

It is well to compare the condition with the prostatic infections of obscure etiology the symptoms of which, signs, course, duration, and treatment correspond with it.

In these cases the colon bacillus is most commonly found in the urine and in pus obtained from the urethra and in many cases a history of intestinal disturbance preceding or coincident with the urethral and vesical symptoms is elicited. Staphylococci and streptococci are also commonly found in this "simple" (so-called) urethritis.

The striking frequency of this urethral and vesical condition in association with tonsillitis and grippe has been observed repeatedly. Hunner has called attention to the association of urethral and pharyngeal conditions and the literature is now voluminous concerning the relations between, or the coincidental abnormalities of certain nasal structures and the urethra and genital organs. In many of these cases symptoms of acute urethral inflammation have been present.

**Treatment of Acute Non-gonococic Urethritis.**—The removal of the cause of the inflammation is the chief feature in its care and no further treatment is usually called for. The calculus, foreign body or catheter must be removed from the canal. Catheterization must be stopped or interrupted for a period when this is possible. The technic of catheterization should be carefully studied and errors corrected.

Injections of argyrol or of some astringent such as zinc sulphate may aid in hastening the subsidence of discharge and relieve discomfort, yet these medicaments are usually unnecessary unless the symptoms persist for three or more days after removal of the cause.

Prophylactic treatment against the chronic urethritis which commonly follows this simple acute urethritis consists in the early recognition of its existence, the correction of the causative factors and local

urethral treatment by means of injections (silver salts, zinc sulphate, etc.) or through the urethroscope (at a later period, not during the acute stage) if the subjective or objective symptoms persist.

**Gonococcic Urethritis.**—Gonococcic urethritis in the female may occasion such slight discomfort and be of such short duration that the patient finds no occasion for recourse to the physician. She may have no discomfort in the urethra and no disturbance of urination—no subjective indication. The fear of detection even in aggravated cases commonly induces the subject to conceal what evidence she has discovered during the short time that symptoms are present.

The very general ignorance of women, of laymen (and it must be admitted of physicians often), of the significance of the symptoms of gonococcic infection in the female with its insidious, far-reaching, and calamitous extension serves to hamper its discovery (often difficult at best) and its prompt efficient treatment. The male practically always knows that he has acquired an infection while the female rarely does.

While one should carefully guard against the indictment of a woman presenting a history of urethral irritability and purulent discharge or of any case with acute, subacute or chronic urethritis, as of gonococcic origin, it may be presumed that a girl or woman exposed to infection of gonorrhea with the history of symptoms of urethritis supervening has had gonorrheal urethritis.

Upon this presumption only rests in many cases the ascribing of the lesions of chronic urethritis, suburethral abscess, infection of para-urethral ducts without demonstration of the gonococcus to an original gonococcic infection, and with this frequently justified presumption many cases are explained.

A woman may have, in fact, commonly does have, a gonococcic acute urethritis without realizing that she is the victim of any pathological process, wherefore her history is not a factor comparable with the search for the pathological evidence and the bacterium. She asserts and believes that there is "nothing the matter with her" and only by the most painstaking scientific search, in which asepsis, perfect clinical and laboratory technic, constant experience with microscope and complete knowledge of the pathology of the disease plays each its important part, can the proof or actual evidence of the nature of the lesion be determined.

Women who present themselves to a practitioner for a certificate of freedom from gonococcic infection commonly are subjected to examination by inspection, palpation, and urinary examination. These means are obviously inadequate for the discovery of nearly all cases except the acute and florid. Most subsiding and chronic cases are not revealed by such superficial means which, so far as they go, give normal signs only, and the proof of the disease is neglected. The failure of medical examination of prostitutes to reveal gonococcic infectiousness is due to the very insidious hiding of the bacterium in folds of the mucosa or beneath the epithelium in ducts and glands.

Gonococci beneath the epithelium actively promoting a small focus of infection are not discoverable by any means. It is only when they come upon the surface or can be brought to the surface that they can be obtained for examination. This is one of the reasons why a single examination is never adequate to give the basis for the opinion that a urethral mucous membrane is not infectious. Several examinations under the most favorable circumstances for finding the bacteria and the most careful observation over a long period of time with complete coöperation on the part of the patient are always necessary before the opinion of non-infectiousness can be given honestly and fairly in any suspicious case.

Lack of coöperation on the part of the patient, who may be very fully informed, will nullify the value of findings in markedly infectious cases of urethritis. Simply by passing through the urethra a small part of the urine just before the examination, all evidence of the presence of pus and bacteria can be washed away and then the urine obtained in the examiner's office is normal, and of urethral secretion there is none.

The patient is then said to have an "irritable bladder," or is said to be suffering from a "psychic or hysterical" complaint, without demonstrable lesion, because the urethra is not subjected to adequate and competent scrutiny.

In such cases the acute condition has disappeared from the greater part of the mucosa, but is persistent as an infection in one or more localized, perhaps minute, areas where redness, swelling and hypersensibility may still be found by means of the urethroscope. These conditions are always obscure until exploration by the urethroscope finds the lesion.

**Pyuria without Urethral Discharge.**—That acute purulent lesions persist in the urethra giving pyuria without discharge of pus from the external meatus and with normal bladder and normal kidneys there is little question. An ulceration or persistent infection at the vesico-urethral junction or in the urethra just outside the internal sphincter has been observed which produced a surprising amount of purulent secretion that passed back into the bladder, making the urine densely turbid. Secretion from this lesion does not find its way through the external voluntary sphincter, but like that of purulent prostatitis in the male, does escape through the internal sphincter into the bladder. Treatment of the bladder in such cases accomplishes nothing but is wasteful of time and effort, while direct treatment of the urethral lesion is the only means of relief.

**Examination for Gonococcic Infection.**—The following plan should be followed when the female urethra is to be examined for the detection of the diplococcus of Neisser, and the same principles apply for examination of the cervix, glands of Bartholin and vagina, all of which are usually examined at the same time.

The patient must take no douche or bath, and must not wash the vulva for twelve hours preceding the examination. She should not

void the urine for at least three hours, and it is preferable that twelve hours elapse preceding the examination. It is often well to instruct the patient to come to the examination early in the morning without voiding urine since retiring the night before.

No washing of the vulva by a nurse is permitted when the patient is prepared for examination.

The labia are separated and specimens of any secretion are taken up with a platinum loop or thoroughly sterilized cotton swabs and spread upon glass slides, labelled according to the site where secretion is found, and cultures made at the same time upon suitable media. Thus often one set of three to six slides is labelled labia minora; another set, vestibule; and still others, external meatus; vaginal orifice; vagina; right Bartholin; cervix, etc. This, it may readily be seen, promises labor for the laboratory, but that is what the laboratory is for, and the duty of the conscientious examiner demands at least that the work be thoroughly done.

Secretion obtainable at the external urethral orifice must be separately collected upon a set of slides to differentiate it from that obtained within the urethra. The urethra may be free of infection while its outlet is bathed in pus from the vagina or from an infected para-urethral duct which may open outside the canal.

The urethral meatus is then opened by separating its margins with the fingers and the vestibule and orifice are washed with cotton sponges wet with salt solution and then dried with sterile gauze. The platinum loop (fired and cooled) or a sterile cotton swab on an applicator is inserted into the canal 0.5 cm. and withdrawn and the secretion upon it spread immediately upon slides. This may be repeated several times to obtain a sufficient number of specimens for careful search. It can be done painlessly and without trauma.

No vaginal examination by means of the finger or speculum should be made until these specimens from the urethral orifice and canal have been secured.

Now the hairpin retractor of Kelly or a bent probe is inserted into the urethral meatus to expose the orifice of one and then the other of Skene's ducts while pressure is made below the floor of the anterior part of the urethra against the vestibule or upon the anterior wall of the vagina, close to the vaginal outlet, and the appearance of secretion expressed from the duct taken up and preserved on specially labelled slides (left, Skene; right, Skene, etc.).

The whole urethra is then stroked from the bladder to the external meatus (from behind, forward) through the anterior vaginal wall. This can be done in infants often without strain or rupture of the hymen.

Several specimens of all secretion thus obtained must be preserved upon labelled slides and cultures made at the same time on appropriate media, such as blood serum, etc., for bacteriological study.

If search is to be made (as must commonly be the case) in the vagina, cervix, vulvovaginal glands, etc., this should now be carried out.

The vagina is then cleansed by douche or by sponges on sponge

holders and mopped dry with gauze or cotton, and the vulva is washed with salt solution and dried with gauze.

The patient is then instructed to urinate into two sterile beakers—a small portion, or the first gush of urine, in one, and the remainder of the bladder contents into the other. All of the urine in glass No. 1 should be centrifugalized and the sediment thoroughly searched for pus and for bacteria, and cultures should be made from this sediment under laboratory precautions.

The patient again takes her place on the table and a critical examination of the entire urethral mucosa is made with the urethroscope, through which all adherent mucus and pus upon the walls is secured for bacteriological examination, and lesions are carefully noted.

No case of suspected gonorrheal infection of the urethra has had a thorough or adequate examination unless a routine as complete as this has been followed, and no case can be declared free of gonorrheal infection unless repeated complete tests of this sort are carried out after stimulation of the urethra and para-urethral ducts with silver nitrate or other irritant directly applied. The doubtful expedient of the ingestion of alcoholic beverage to irritate this part of the urinary tract may aid in promoting the appearance of discharge, which is to be searched for the offending organism.

**Acute Gonococcic Urethritis.**—This is an acute exudative inflammation of the mucous membrane involving the entire extent of the canal, due to the lodgment and growth upon and in the mucosa of the gonococcus or diplococcus of Neisser.

It is acquired by adults almost exclusively in coitus, although the bacteria may be transferred through freshly soiled objects, such as douch-nozzle, towels, toilet seats, etc. Infection except through sexual contact is very rare in adults, while the transference of the bacterium from an infected source to the more delicate and more susceptible mucous membrane of the vulva of the infant or young girl is common through contaminated objects, such as clinical thermometers, diapers, towels, toilet seats, the hands of attendants and nurses.

The little girl who sleeps in bed with an infected individual may acquire this infection from secretion deposited upon the bedclothes or through handling by infection-carrying hands. This source of infection is common among the poorer classes who visit our free clinics, and is not uncommon among all classes. In children the urethra is readily infected, but is rarely the site of persistent and chronic foci. Long-continued vulvovaginitis in children is usually due to chronic infection in the cervix uteri. Repeated reinfections of the urethra from this source may occur.

Acute gonococcic urethritis in the female is usually a short-lived process, lasting from three or four days to three weeks in untreated cases. The acute symptoms consist in itching or burning in the urethra, with a scalding sensation during urination, frequent desire for micturition, more or less urethral discharge of pus containing gonococci, and occasionally some blood or terminal hematuria. These symptoms

last for a few days and arouse often slight attention on the part of the victim, so that she does not consult a physician. When the pain is great or frequent, imperative calls for urination with strangury arise, or the discharge is florid and she is unaccustomed to vaginal discharge, or blood is observed at a time apart from a menstrual period, any of these conditions may lead her to seek medical examination for relief. It is, however, to be remembered that a woman will usually patiently bear the above-mentioned discomforts in the hope that they will soon pass away, and she commonly ascribes them to some indiscretion in diet. Her hope is often fulfilled, and she believes herself unaffected by any serious condition because of the subsidence of all subjective symptoms after a few days. On the other hand, symptoms may be aggravated and prolonged, and the victim may immediately seek medical advice.

On examination in the acute case the external meatus is dark red and swollen, with discharge flowing from it or readily expressed by the slightest pressure. The vestibule, meatus, and urethra per vaginam are exquisitely tender to touch. The secretion transferred to a microscopic slide shows pus with the characteristic biscuit-shaped extracellular and intracellular diplococci, which are negative to the Gram stain, and cultures from this secretion grow the characteristic colonies of this organism on suitable media. The orifices of Skene's ducts may stand out as pouting red points when exposed just within the meatus. Pressure upon these ducts through the vestibule or through the vagina shows a drop of pus at the orifice, and palpation of the urethra per vaginam gives pain, causes an increase of the discharge at the meatus, and the normal cord-like feeling of the urethra above the vagina is changed by the soft thickening of its walls, due to the inflammatory infiltration. If gonococci are not found in the secretion from the urethra, but are present at this time in secretion from other parts of the genital tract, this bacterium may reasonably be presumed to be the exciting cause of the acute urethritis and subsequent searches will usually reveal them in the urethral secretion.

The examination of the vagina, vulvovaginal glands, and cervix is now usually proceeded with and the vagina cleansed and dried with gauze, and the vestibule, labia, and vaginal outlet cleansed by washing and dried with gauze.

The patient passes urine into two sterile beakers. In the portion voided first, shreds, pus and gonococci are found. The second beaker may contain clear urine or it may be cloudy or turbid with pus. The pus in the second beaker may be due to purulent inflammation in the juxtavesical portion of the urethra corresponding with posterior urethritis in the male; it may be due to cysto-urethritis or to cystitis.

In acute inflammation of the urethra, when the gonococcus is readily demonstrated in the secretion, no urethroscopic examination should be attempted. It is painful, requiring thorough anesthesia with novocain or cocaine, and the introduction and manipulation of the instrument produces traumatism, with trifling hemorrhages even in the most deft

hands, tending to give rise to extension and aggravation of an already grave inflammatory process. No catheter or other instrument should be passed through an acutely inflamed urethra unless imperatively necessary.

If voluntary urination is interfered with by reason of the pain and swelling in the canal, the patient must be instructed to attempt to void urine while sitting in the hot sitz bath or while hot applications are made to the vulva and pubic regions, so that catheterization and its trauma may be prevented.

During or subsequent to the acute stage of gonorrheal urethritis the inguinal lymph nodes may be found to be enlarged and tender or even to be the seat of abscess formation.

After a few days (one to ten days, but two to four days commonly) the subjective and objective symptoms and signs rapidly disappear. Urination becomes normal, urethral discharge is slight, mucoid, with little pus, and the redness and swelling of the meatus disappear. There persists, however, for ten to fourteen days longer the evidence of urethritis in shreds in the urine, a little more than normal secretion from the mucosa, and pus is to be found in the shreds and in the urethral secretion as well as some gonococci.

The orifices of Skene's ducts will usually show for a week or two as distinct red points, just within the meatus on each side, and from them may be expressed a tiny drop of pus in which gonococci may be found on careful search.

If the urethroscope is employed in this stage, red points and infiltrated areas are to be found along the urethra, and these are most numerous and most marked in the parts of the mucosa which are provided with glands, notably at the upper extremity and near the external meatus. These infected areas are the lesions which persist as chronic foci of inflammation.

In this subsiding stage the woman may consider herself well even if she has recognized during the florid stage that a definite disease process has been in action, yet the secretion from the urethra is highly infectious.

Now the active process has subsided, and there persists for a short or long time the periods described as the subacute and chronic stages.

The subacute stage is merely a continuance of the subsiding acute process. It is an indefinable period, during which very slight subjective and objective symptoms and signs remain. It may be said to have a duration of from two to five weeks.

It is well known and has been stated above that acute gonococcic urethritis in the female usually subsides in less than ten days to a subacute condition of relative comfort, as the patient observes, and one in which the objective signs are scarcely manifest. This subacute stage has a duration of from ten days to five weeks. Urethritis persisting longer than five weeks is to be called chronic.

The pathological condition has during the first two to ten days been an active acute exudate inflammation of the entire mucous membrane. The entire inner membrane (epithelium) is during this stage swollen,

deep red in color, and covered with yellow fluid pus. The bloodvessels are dilated, leukocytes are packed into the submucous and mucous layers and escape upon the surface, which is secreting an abnormal quantity of mucus, and the epithelium is desquamated as individual cells or in plaques or groups of cells. Minute hemorrhages take place into the mucosa and upon its surface. The gonococci are to be found in the epithelial cells and penetrating between cells in the mucous and submucous layers, and within the leukocytes.

Wherever crypts, lacunæ, folds, or glands exist the inflammatory process extends into the depths, and gonococci penetrate into the lowermost recesses and out into the surrounding tissues about such crypts and glands. Minute abscesses are thus formed, which, bottle-like, may be shut off from the canal through adhesion or occlusion of their outlets, to open again as the inflammation surrounding them subsides, with discharge of the infectious contents into the main channel of the urethra, giving rise to recrudescence or recurrence of the diffuse inflammation throughout the canal. These pockets of infection in glands, crypts, and sulci are the sites of long-persisting lesions, often microscopic in size, but large in their potency for recurrent or chronic infection. Some minute lesions may extend or coalesce to form gross areas of suppuration, called suburethral and peri-urethral abscess, and perforation of such a suppuration through the vaginal wall brings about urethrovaginal fistula. It is to be particularly noted that glandular structures are found in the upper third and in the lower third of the urethra, and that these portions present the chronic lesions and are the sites of suburethral abscess.

Infection of the para-urethral (Skene's) ducts affords a nidus for long-continuing suppurative inflammation or recurrent abscess formation. In glands and gland-like structures the gonococcus finds its natural habitat, and it is in these structures that it maintains acute, subacute, and chronic inflammation untouched by medicaments applied to the lumen of the urethra, and undiscovered, it may be, by any of the means which we now possess for searching it out.

**Treatment of Acute Gonococcic Urethritis.**—It may be stated, at the outset, that the proper care of any woman infected by the gonococcus demands the most painstaking attention to every detail, and treatment to be effective must be carried out in part by a nurse and in part by the surgeon. A nurse should care for her wants while she remains in bed, apply compresses, give urethral treatments, regulate the diet, and see that water is taken. This can be accomplished only among those who have command of their time and the means to provide themselves with every necessity. In many cases no such plan can be carried out. The patient may not, for varied reasons, take to her bed, admit a nurse to her home, and permit daily treatment by a surgeon. The feasible approach to ideal care often consists in the daily visit to the physician's office, where treatment is administered. A daily renewal of the antiseptic tampon and irrigation of the urethra can be made. The effectiveness of these means, however, is lost after a few hours, so that she is

practically without treatment during the greater part of each twenty-four hours.

Abortive treatment is impracticable because of the fact that the appearance of symptoms sufficiently marked to attract the patient's attention indicates a stage of inflammation when the bacteria have penetrated beneath the superficial epithelium, so that medicaments applied to the surface fail to reach and kill them.

The vagina, vulvovaginal glands, and cervix must be protected, if not already infected. If infection has taken place in any part of the genital tract, appropriate treatment must be carried out at the same time with that directed to the urethra.

In the very acute, florid, and fortunately rare cases of urethritis, with exquisite pain and tenderness, no local treatment should be undertaken until the aggravated symptoms have subsided; but the protection of the vagina and cervix may be attempted in some cases by the insertion, twice daily, of a tampon saturated with 2 per cent. protargol and the repeated cleansing of the vulva with warm solution 0.5 per cent. protargol or 1 to 2000 potassium permanganate. Vaginal douches administered by the patient herself present an element of danger in the introduction of a nozzle which may carry contamination as it enters the vagina. The application to the vulva of clean hot compresses, frequently renewed, offers the safest palliative measure.

The patient should remain in bed and an opiate given, if necessary, to secure quiet. She should be kept upon a fluid diet, milk chiefly, and drink copiously (10 to 15 glasses a day) of water, preferably alkaline water. This course is required for two or three days at most, when the pain usually subsides.

In the less aggravated cases the application of clean hot compresses is beneficial, while the patient remains in bed for the greater part of the day and limits exercise to the minimum. The compresses should be available in abundance, and each should be destroyed after once having been applied, so that the infectious secretion is removed. A compress is removed when cold or soiled, and at each micturition.

A vaginal tampon soaked in 2 per cent. protargol or other antiseptic is to be renewed daily.

Injection through the urethra (argyrol, protargol, silver nitrate, potassium permanganate) into the bladder (with the aid of novocain 1 per cent. previously if need be) should be used during the active stage four or five times in twenty-four hours. Sufficient quantities (3 iv to vj) should be used so that the bladder is filled and stimulated to expel the fluid again through the urethra in voluntary urination. If silver salts (argyrol, protargol, silver nitrate) or potassium permanganate (1 to 2000) is used, there is little danger of infection of the bladder by this means.

The use of a catheter or recurrent irrigating tube (Janet) or other instrument in the inflamed urethra is contra-indicated. Its trauma is more to be feared than that of an antiseptic fluid gently injected, which enters the bladder and is expelled again voluntarily.

Bland, simple diet, consisting largely of milk and laxative food, should be taken. Alcohol and condiments must be avoided. The bowels should be kept free by some vegetable cathartic. Laxative salts and aperient waters often are irritating.

The treatment of the subsiding stage of the acute gonococcic urethritis consists in a relaxation of the strictness of diet and quiet, but by no means of the local treatment. Antiseptic tampons should still be used daily to serve as protection against infection of the cervix. Injections of one of the silver salts per urethram are to be continued daily, twice or three times if possible. Copious water drinking should continue and condiments and alcohol must be avoided. Exercise should be limited.

The conclusion that a cure has been obtained can only be reached when repeated search for the gonococcus has failed to reveal its presence, when no pus is found in the urethral secretion or in voluntarily voided urine, when no sign of inflammatory lesion is found in the mucosa examined by urethroscope or about the external meatus, and when the gonococcus complement-fixation test of the patient's blood proves negative. Not one or several of these factors are adequate for a clean bill of health. All must be clear in indication of health before the patient is to be regarded as cured.

It is well to be ultracautious and conservative, and to give no assurance of cure until one to three months after an apparent cure, during which period examinations of the parts affected and searches for the bacterium are to be made at intervals. Unsuspected recrudescence is common.

**Complications of Acute Urethritis.**—Acute urethritis is in practically every case which is due to the gonococcus accompanied by infection of the para-urethral glands—Skene's ducts.

The treatment of these infected ducts is best carried out after the acute urethritis has subsided, and should consist in the effort to destroy the duct by cauterization. The injection of antiseptics or weak solutions of caustics, so generally advised, is usually a prolonged treatment and futile as a curative measure.

The duct can usually be sounded by a fine probe or large hollow needle, the point of which has been dulled and rounded. The wire electrode for high-frequency spark cauterization or galvano-cautery can thus be used to destroy the infected channel, or injections of strong silver nitrate solution, 20 per cent. to 50 per cent., or of 95 per cent. carbolic acid may be made into the depths of the duct through a needle such as used for intramuscular mercurial injections.

Cystitis or inflammation of the trigone or vesical outlet (cervico-urethritis) commonly complicates urethritis in the female. Treatment of the urethral inflammation disregarding the bladder usually results in speedy recovery of the bladder inflammation.

Topical applications to the trigone and vesical outlet may be necessary during the subsiding stage. Treatment, however, which consists

in injections through the urethra into the bladder accomplishes the double purpose.

Suburethral abscess is a complication of acute or chronic urethritis, which fortunately rarely follows. This abscess is found below the urethra in the urethrovaginal septum by extension from submucous glands, which are infected and do not discharge their contents into the urethra. The periglandular tissues are infiltrated and inflamed, or several minute intraglandular abscesses fuse together to form a gross lesion the size of a hazel nut or hickory nut, giving rise to great pain, exquisite sensitiveness, and pain and difficulty in voiding urine.

Suburethral abscess is found beneath the anterior one-third of the urethra, in which case the para-urethral ducts are usually the seat of origin of infection or the suburethral abscess is found below that part of the urethra nearest the bladder (posterior one-third) when the origin is in the glands of the mucous membrane of this part. The proximity to the internal vesical sphincter gives rise to great pain, constant desire to void urine, strangury, etc.

Suburethral abscesses tend to rupture into the urethral canal rather than through the denser tissues of the vesicovaginal septum and the vaginal mucosa, which sometimes does take place.

The treatment of suburethral abscess consists in giving vent to it as promptly as possible. This can be accomplished by incising the overlying vaginal wall into the abscess cavity, but the danger of urethrovaginal fistula as a consequence is great and its repair may be troublesome at a later date. This should be the treatment of abscess near the external meatus. The writer believes it to be preferable in the case of abscess near the bladder (posterior one-third) to give a general anesthetic, dilate the urethra to normal limits (30 or 31 Charrière scale) and, if this does not result in discharge of the abscess into the urethra, to incise the floor of the urethra into the abscess, to give the natural physiological drainage without opening the vaginal wall. The likelihood of fistula formation is less and healing has been prompt and uneventful in one or two cases so treated. Bleeding may be quite profuse, but is usually controllable by pressure per vaginam. A retained catheter is usually necessary for a day or two, and opiates are required to control the pain.

**Chronic Urethritis.**—Inflammations of the urethra which persist over a long period of time are found in the female as in the male almost without exception in and about glands of the mucous membrane or in gland-like structures. Chronic urethritis is usually the aftermath of an acute inflammation and the persistent lesions are confined to those parts in which glandular structures are found, namely, in the proximal one-third or the distal one-third of this tube. While in many cases it is difficult to demonstrate a purulent exudate in urethral discharge, in shreds in the urine or in suppurative foci by means of urethroscopic examination, there is always a suppurative process going on in the tissue as the basis of this chronic urethritis. When the gonococcus has been the original invader, this organism may in many cases persistently reside in the depth of gland-like structures and maintain a low grade of

suppurative inflammation. When the gonococcus is recoverable in the urethral exudate the diagnosis of chronic gonococcic urethritis is made. When, however, the gonococcus is not demonstrable in the secretion obtainable from the urethra while other organisms are present, the organism found may be either the original invader or it may be one which has replaced the gonococcus in the inflammatory tissue (secondary infection).

The sequela of chronic inflammation, such as stricture, "proliferating urethritis," and "fibrous urethritis" (Legueu) have been considered elsewhere.

Infection by the gonococcus is the most frequent cause of chronic urethritis, and, while authoritative statistics upon its frequency are not available, it is recognized as a common condition. Many cases of chronic urethritis are ascribable, with reasonable presumption, to a previous transient acute urethritis of gonococcic origin.

Many cases of chronic urethritis in women, on the other hand, are the result of acute infection of the glandular structures of the mucous membrane, especially in the juxtavesical portion of the canal produced through traumatism during catheterization, during childbirth, and through various possible injuries of the urethra, as well as the results of those little-understood and often inexplicable cases of urethral lesions occurring during epidemics of grippe, and as complications of tonsillitis, pharyngitis, nasal and dental lesions. The writer has seen cases of urethral inflammation with purulent exudate coincidental with suppuration about a tooth which disappeared (were apparently cured) when the dental lesion was removed.

**Pathology.**—The pathological condition differs from that found in acute urethritis in the absence (usually) of inflammation diffused throughout the entire mucous membrane of the canal, while the glandular structures maintain the discrete foci. There may be but one gland-like structure involved, as when one of Skene's ducts presents the only focus, or multiple foci may be present, as when many minute lesions are found in the upper or lower portion of the canal. These lesions may give rise to a visible purulent exudate which is found at the external meatus or is readily brought to view by pressure upon the canal in such a way as to force it to the meatus. There may, on the other hand, be so minute an amount of exudate that none is visible even after massage of the urethra, and centrifugalization of the first portion of urine passed may reveal only a few scattered leukocytes by microscopic examination of the sediment.

Chronic urethritis is observed in all ages, uncommonly in childhood, more frequently in young adults and is most common in those who have borne children. It is not uncommon in women of advanced age.

**Symptoms.**—The symptoms of chronic urethritis are those so often erroneously attributed to "cystitis" and "irritable bladder," namely, discomfort or pain, painful urination at the bladder outlet, abnormally frequent desire for urination, rarely urethral discharge, pus and shreds in the first portion of urine voided, pyuria and hematuria in some cases.

The symptoms of vesical irritability, discomfort at the bladder outlet, sense of titillation, pain on retention of urine, frequent or constant desire to pass urine, are all sensory disturbances arising in the urethra, producing impulses to the reflex centres of micturition. When inhibitory control of this reflex is inefficient to check it, involuntary urination takes place.

If such injury as the traumatism to the urethral structures produced in some cases of childbirth has weakened the internal and especially the external voluntary sphincter, the irritation caused by the lesions of chronic urethritis may start the reflex of micturition, and the damaged musculature of the sphincters fails to occlude the canal in spite of voluntary efforts, and involuntary micturition takes place.

Changes in the urine may be noticed by the patient if marked pyuria or hematuria is manifest. Marked pyuria may be due to a chronic suppurative lesion in the urethra, outside of the bladder, whose exudate passes back through the sphincter, clouding the bladder contents. Extension of the urethral inflammation through the sphincter to the mucosa within the bladder, upon the trigone and about the vesical outlet is common but does not always take place.

All cases presenting the above-mentioned symptoms should be subjected to critical examination of the urethra.

**Diagnosis.**—Palpation of the urethra per vaginam will usually localize areas of special tenderness, and rarely small nodular thickenings or larger infiltrations can be thus appreciated. Exudate can sometimes be expressed from the meatus by pressure upon the canal per vaginam from the bladder outlet downward to the urethral orifice. This exudate is to be examined carefully for morphological elements (pus particularly) and by search for bacteria in stained spreads as well as culturally. The type of bacterium should always be determined.

Exposure of the lower 1 cm. of the urethra about the external meatus by means of retractors will often reveal the inflammatory swelling, redness, and exudate present in this part.

The orifices of ducts which open upon this mucous membrane, are often plainly visible to the naked eye, but more clearly seen with a magnifying glass by red areolæ surrounding them.

The lesions inside a narrow meatus and those located farther within the urethra are only discoverable through the urethroscope. In fact, no case of chronic urethritis can be diagnosed or efficiently treated without the use of the urethroscope.

By means of the urethroscope areas of soft infiltration, of dense induration, as well as the common multiple minute points of swelling, redness, and suppuration can be readily recognized and directly treated. "Granular urethritis" is the chronic inflammation of the mucous membrane which resembles granulation tissue and is found in isolated circumscribed areas or occupying the whole extent of the canal. The gross appearance as seen by the urethroscope is the same in the chronic inflammation due to the gonococcus and in that due to pyogenic cocci, the colon bacillus or other organisms. The differential diagnosis

between the inflammations produced by different bacteria is made solely by the demonstration of the bacterium present.

**Treatment.**—The treatment of chronic urethritis produced by the gonococcus and by other organisms is in general the same, and consists chiefly in direct topical application to each lesion. This can be done satisfactorily only through the urethroscope.

Gonococcic inflammation because of its infectiousness demands special and stringent precautions against transmission to others. When chronic gonococcic urethritis is present, all contaminated vulvar pads, compresses, clothing, etc., must be destroyed or sterilized and preserved from contact with other individuals. Coitus is interdicted and the patient, nurses, and others concerned in the case must be instructed concerning the dangers of contamination to the eyes and other parts, and the strictest cleanliness observed. The dangers of infection of children (male as well as female) must be particularly pointed out. The patient must sleep alone.

The direct treatment of the lesions discovered by the urethroscope aims to destroy each focus. If the superficial tissue (*the mucosa of the canal*) presents evidence of inflammation, each point should be treated by applying silver nitrate solution upon a small swab through the urethroscope. Novocain or cocaine anesthesia may be needed for each examination and treatment. The strength of solution of silver nitrate applicable varies with each case. Usually it is best to begin with a weak solution and observe the result, but the strongest solution up to 20 per cent. or even to the use of the pure stick silver nitrate fused upon a probe should be employed when possible. The high-frequency spark after cocainization is in some cases very effective especially when hypertrophic tissue is found.

The result of any treatment of the urethra is in some cases surprisingly painful after the effect of the local anesthetic has been lost, so that the direction should be that the patient keep as quiet as possible (in bed) for three to six hours after the treatment, and resort to hot sitz baths, hot douches and hot applications, hot-water bag, compresses, etc., as needed. Morphin is required in some cases.

Lesions which lie beneath the surface epithelium must be exposed for treatment and for free drainage or destroyed by the high-frequency spark. Localized indurated areas which harbor a chronic inflammatory focus should be incised with a knife, or scissors of special form, through the urethroscope or laid open by the electric cautery knife or actual cautery.

Para-urethral ducts which persistently harbor infection are treated by passing a small hollow needle through the extent of the duct and injecting slowly a drop or two of 95 per cent. carbolic acid or 20 per cent. silver nitrate, or by passing the wire electrode and destroying the duct by cautery or high-frequency current. These means of treatment of chronic infection of para-urethral ducts are often adequate, but some cases are more promptly cured by incising the canal upon a fine grooved director, to lay it open upon the vaginal wall for evacuation of its con-

tents and direct treatment of the tissue involved. Suburethral abscess is rarely the lesion maintaining a chronic urethritis.

Chronic urethritis is by these means curable. The treatment may demand application to the diseased area once in ten days for a long period (one to six months). Four to six treatments are almost always required before the patient experiences decided relief from the distressing subjective symptoms, and still more treatments are usually needed to restore the pathological areas to normal appearance.

An area of urethral mucous membrane (glandular structures) which has once harbored a chronic inflammation remains a part of lowered resistance, so that a recurrence (reinfection) is common. Each recurrence requires repetition of treatment, but recurrences recognized and treated at their inception are usually readily controlled. Cases of chronic urethritis complicated by incontinence of urine are common.

The cure of the inflammatory lesion often results in complete restoration of urinary control. When the incontinence is due to damaged tissue of the sphincters or to laxity of the urethral tissues produced by urethrocele, cystocele, or prolapse of the uterus, bladder and urethrovaginal tissues, operative restoration to normal conditions must be sought.

Nervous diseases which affect the bladder and its sphincters must always be sought for in every case presenting symptoms of chronic urethritis, incontinence or retention of urine, or pain referred to the urethra.

No case presenting typical signs and symptoms of chronic urethritis should escape examination for those vesical, pelvic and nervous conditions which produce similar symptoms and signs.

#### BIBLIOGRAPHY.

1. Kalisher: *Urogenit. Musculatur des Dammes*.
2. Luciani's *Human Physiology*, ii, 461.
3. Neuberger: *Berliner klin. Wehnschr.*, 1894, No. 20.
4. Nové-Josserand and Cotte: *Revue de Gynécol. et Chir.*, 1907, xi, 963.
5. Schäfer: *Microscopic Anatomy*, Quain.
6. Stöckel: *Veit's Handbuch der Gynecol.*, ii, 287.
7. Virchow: *Archiv für path. Anat.*, 1853, v, 403.

## CHAPTER XI.

### STRICTURE OF THE URETHRA.

By EDWARD L. KEYES, JR., M.D.

#### URETHRAL STRICTURE.

STRICTURE of the urethra is an abnormal constriction or loss of distensibility of that channel.

Stricture occurs in the female as well as in the male urethra. In either sex it may be classed as congenital, inflammatory, and traumatic.

Further subclassification may be made as follows:

Stricture of the male urethra	{	Congenital.
		Traumatic.
		Inflammatory.
		Gonorrheal.
		Tubercular.
Stricture of the female urethra		All others.

It is important to specify how much narrowing or loss of distensibility of the urethra constitutes stricture, for whether the lesion be congenital or acquired, it merits the name of stricture only after it has reached a point of contraction at which it is inevitable either that symptoms result or that further contraction ensue. But the size varies with different types of stricture as well as for different urethræ. It is equally impossible to specify the precise size to which a stricture must be dilated in order that its tendency to recontraction may be controlled.

Thus a congenital stricture no larger than 20 F. is likely to give no symptoms unless its possessor acquire a gonorrhea, which cannot be cured until the stricture is cut.

On the other hand, any traumatic scar surrounding the urethra will soon contract sufficiently to cause symptoms to be clinically a stricture.

For gonorrheal stricture, Oberlaender recognizes "hard infiltrations" of various degrees (p. 301), a urethroscopic tube of 23 F. size being the criterion. Infiltrations of the first degree do not perceptibly impede the passage of the urethroscope and are not lacerated by it. Infiltrations of the second degree admit the instrument but are abraded by it. Those of the third degree do not admit the urethroscopic tube. We may accept this classification and recognize that infiltrations of the first degree only remotely and rarely form the basis of stricture, while those of the second and third degree may be spoken of as true strictures.

It is to be remembered, however, that the sound or bougie commonly employed for the diagnosis of stricture engages in a stricture far more gently than the sharp-edged urethroscope. Hence, the sound to be used should be several sizes larger, viz., about 26 F.

This distinction between an infiltration of large caliber and one of small caliber is not an artificial one, for the gonorrheal scar that does not offer any impediment to the passage of a 23 F. urethroscope, or 26 F. sound, is so slight a scar and impedes the outflow of urine so little that the congestion upon its surface is likely to remain slight; and even though untreated, it may probably (and in some cases certainly) cause no stricture, no real constriction of the urethra, even after many years.

Moreover, the diagnosis or treatment of these infiltrations of the first degree is rather that of the urethritis which they maintain than of the scar itself. They are diagnosed by the urethroscope and the bulbous bougie, while the true or tighter strictures may be better diagnosed by the sound. They are treated largely for the purpose of curing the urethritis upon them and behind them, with the assurance that if this urethritis is thoroughly cured the infiltration of the first degree will show no further tendency to contract and the urethritis no more than a very remote tendency to relapse.

Thus we may dismiss the whole subject of infiltration of the first degree to the topic of chronic anterior urethritis, where it properly belongs. With it we dismiss the theory of strictures of large caliber, promulgated fifty years ago by Otis, and which for a quarter of a century dominated the treatment of chronic urethritis in this country.

Otis's claim that the urethra is an evenly calibrated tube, bearing a certain relation to the size of the penis, is too fantastical and medieval even to require discussion at this day. His routine practice of cutting the urethra to such size as 40 and 45 F. cannot be too thoroughly condemned as a routine, for the knife should, as far as possible, be replaced by the dilator, and the object of treatment of infiltration of the first degree should be, not the dilatation of the urethra to a theoretical limit, but the cure of chronic urethritis, by whatever dilatation is necessary to that end. In exceptional cases internal urethrotomy is required for the treatment of chronic urethritis just as much today as it ever was.

**Statistics.**—Our knowledge of the pathology of urethral stricture is founded upon the researches of Sir Henry Thompson on stricture itself, and those of Oberlaender, in Vienna, and of Wassermann and Hallé, in Paris, on chronic urethritis and the inflammatory process which leaves the scar we call stricture. Upon this basis of pathological fact we shall found our clinical observations.

These relate to 583 cases of gonorrheal stricture, 55 cases of traumatic stricture, a large number of congenital strictures, almost all at the meatus, and a few due to tuberculosis, syphilis, and other causes. The mere number of these cases might be equalled in the case books of any urologist, but their interest arises from the fact that almost all of them

were private patients\* whose condition was noted with care for a considerable number of years. Of no less than 120 we have records extending over ten years or more, while of one-half of these (62 to be accurate) the records extend for twenty years or more. Thus we are able to estimate the progress of this disease and the result of its treatment rather more accurately than has been heretofore done.

### GONORRHEAL STRICTURE OF THE MALE URETHRA.

Gonorrheal stricture of the urethra is a scar in the wall of the canal produced by gonorrheal inflammation of its glands—a scar of sufficient extent to grasp a 26 F. sound.

**Etiology.**—The cause of gonorrheal stricture is not simply gonorrhea. Indeed, stricture very rarely follows a well-treated gonorrhea. The relative frequency of stricture in the clinic as compared to private practice is evidence that neglect and the trauma of unskilful local treatment play a large part in its etiology.

Thus sometimes the brutal breaking of a chordee, or the clumsy passage of a sound actually tears the mucosa and produces a stricture that is more traumatic than gonorrheal. Yet, as a rule, the trauma is only a subsidiary cause. The careless instrumentation or overfrequent injection merely intensifies, instead of lessening, the infection, inflames the urethral glands more severely, increases the periglandular exudate, and thus produces more scar, more stricture.

Stricture is due rather to intensity than to duration of urethritis. To be sure, Wassermann and Hallé† long ago proved chronic anterior urethritis a sclerotic process; but their inference that stricture is due to chronic urethritis is not justified, for the extent of the sclerosis in chronic urethritis is determined, not by the duration of chronic inflammation—ancient anterior urethritis without stricture is a commonplace observation—but by the acute outbreaks that precede or interrupt it. Stricture and chronic urethritis have a common cause. They do not cause each other; though stricture keeps up the inflammation, while this in turn adds to the scar.

**Pathology.**—Gonorrheal stricture is but a cicatrization of the pathological process that causes chronic anterior urethritis. The pathology of stricture begins, as it were, where that of the active inflammation leaves off. Gonorrheal anterior urethritis becomes chronic through continued suppuration in the glands of the urethra. The glands continue to suppurate because of bad drainage, their ducts being obstructed by the inflammatory exudate in the urethral wall. This inflammatory periadenitis varies in extent and intensity; sometimes a mere swelling of the mucosa itself, sometimes extending with the glands, and beyond

\* From our hospital records we have borrowed only the operative statistics of perineal section.

† We assume the reader's familiarity with the phenomena of chronic urethritis, described in Chapter IX.

the glands, into the surrounding corpus spongiosum, and even beyond this into the subcutaneous tissue. These processes have been described in reference to gonorrhea. Suffice it to state that the mildest of them results in superficial scarring of the mucosa, which at most can only cause a slight contraction of the urethra. The more extensive and intensive processes result in grave stricture, peri-urethral abscess, fistula, etc.

With the cicatrization of this peri-urethral exudate a scar is formed in the urethral wall. This contains a large proportion of elastic fibers. It tends to contract. It diminishes the lumen of the urethra. At first the actual encroachment upon the urethral lumen is slight, but the physiological impairment is great. The outflow of the urinary stream meets an obstacle in this rigid portion of the urethral wall, an obstacle that continues to harbor gonococci or other bacteria in its inflamed glands, and whose surface is eroded or ulcerated. Repeated impact of the urinary stream against this tends to dilate the urethra behind it and to intensify the chronic urethritis about it. As a result, more periglandular exudate is formed, more scar results, the urethral lumen is still further narrowed, while the chronic urethritis is encouraged. The complications of anterior urethritis, viz., peri-urethritis and peri-urethral phlegmon, abscess, and fistula, are common results of neglected stricture.

Urinary sepsis due to retention and infection of the upper urinary tract results from stricture, just as it does from prostatism (*q. v.*); but inasmuch as the patient with stricture is usually several decades younger than the possessor of an enlarged prostate, his younger and stronger muscles tell in his favor. His bladder is more likely to become hypertrophied (sclerosis with thickening of the wall, but without dilatation of the cavity) than atrophied. If relieved of his stricture, even after his kidneys have suffered grave damage, his expectation of life may be considerable.

Postmortem examination of urethral stricture may only reveal a transverse scar in the mucosa so slight that it can be felt rather than seen when the urethra is split open. The surface of the mucosa may look normal; it may be eroded, granulating, pouched from back pressure, or, in the more extreme cases, utterly distorted by irregular masses of scar and areas of suppuration.

**Location of Stricture.**—In the preceding paragraphs gonorrheal stricture has been described as though it affected the anterior urethra exclusively. Such is not the case. Gonorrheal stricture of the membranous urethra has been observed, and one occasionally operates upon a urethra strictured not only from meatus to bulb but also throughout the posterior urethra.

Gonorrheal stricture of the posterior urethra does not, however, concern us here. Its one important clinical expression, viz., stricture at the neck of the bladder, gives the symptoms of, and is therefore dealt with in connection with, prostatism. Stricture of the remainder of the membranous and prostatic urethræ is never seen alone; it is but a

complication of graver stricture in the bulb.\* With the exception of stricture at the neck of the bladder, gonorrheal strictures of the posterior urethra may therefore be dismissed with the statement that they add nothing to the clinical picture or to the treatment of gonorrhea of the anterior urethra. They appear indeed to be singularly amenable to dilatation.

In the anterior urethra, gonorrheal stricture is coterminous with gonorrheal urethritis, with the urethra itself. An utterly neglected case thus sometimes presents irregular bands of stricture at short intervals from one end of the urethra to the other. But such cases are rare. The symptoms of neglected stricture usually cry for relief long before so extensive a process can develop.

In the majority of cases strictures are pathologically single, though they may be clinically multiple, *i. e.*, there is but a single scar affecting a greater or less extent of the urethra, upon the surface of which there may be one or more ridges presenting points of obstruction to the examining instrument. Hence the clinician notes the frequency of multiple strictures while the pathologist asserts their rarity in that very class of (postmortem) cases in which their multiplicity should be most apparent. Thus Thompson<sup>10</sup> found only 41 cases of multiple stricture among 270 museum specimens. Only 8 of these extended throughout the urethra.

Thompson<sup>10</sup> suggests the following division of the urethra for the classification of gonorrheal strictures:

1. "The bulbomembranous, from one inch in front of to three-quarters of an inch behind the junction of the spongy with the membranous urethra. This region contains the majority of strictures; they lie rather in front of than behind the junction of the bulb with the membranous urethra.

2. "From the anterior limit of region 1 to within  $2\frac{1}{2}$  inches of the meatus."

3. "The terminal  $2\frac{1}{2}$  inches of the canal."

Thompson found 215 (67 per cent.) strictures in region I, 51 (16 per cent.) in region II, 54 in region III. Among 564 of our cases 345 (61 per cent.) were in region I.

**The Form of Stricture.**—It is convenient to speak of linear, annular, or tortuous strictures. These terms correspond to clinical characteristics.

Two more important points in reference to the form of stricture must be borne in mind: In the first place the scar of stricture is built up chiefly from the floor of the urethra. Its orifice is therefore eccentrically placed and usually near the roof of the canal.

In the second place, irregular, multiple strictures usually become progressively narrower as they approach the bulb. Even though the stricture extends over only a short portion of the urethra, its tightest point is likely to be the deepest; while if its extent is considerable,

\* Thompson states that while stricture is most common in the bulb, "the liability of this part to stricture appears to diminish as it approaches the (bulbomembranous) junction, where it is less common, while behind it is very rare."

examining instruments impact upon tighter and tighter bands until the tightest point of all is found in the deeper portion of the bulb. Thus the minimum size noted by us in 459 cases is shown in the subjoined table:

	In regions II and III.	In region I.
Impassible . . . . .	3	35
Filiform to 9 F. . . . .	21	131
10 to 19 F. . . . .	68	88
20 to 26 F. . . . .	62	51
	<hr/> 154	<hr/> 305

Hence, of the anterior strictures, less than 16 per cent. contracted below 10 F., while of the perineal strictures, 54 per cent. did so. Anterior strictures contract to a far less degree than perineal strictures.

This is doubtless due to the fact that rapidity of contraction in a stricture is in proportion to the irritation to which it is subjected, the band of scar nearest the bladder receiving the full impact of the urinary stream, thus contracts most rapidly.

**Symptoms.**—The symptoms of urethral stricture, like those of prostatic retention, may bear little relation to the gross pathological condition. Thus a patient complaining only of a chronic urethral discharge may be found to suffer from an extensive and very tight stricture; while another who suffers from acute complete retention of urine may have but a single narrow band that obstructs the urethra rather by congestion than by actual contraction of scar. Furthermore, the most treacherous stricture cases resemble those cases of prostatism of which the local symptoms are few, but whose general debility, resulting from mild chronic urinary septicemia, may bring them to a state of incurable renal deficiency before they even consult a physician.

**Onset.**—The accompanying table compiled from our cases and those of Sir Henry Thompson shows that the symptoms of stricture usually begin within one year of the gonorrhea causing it. Exceptionally, and doubtless through neglect on the part of the patient to be thoroughly treated for a chronic urethritis, the slight scar resulting from this may, after many years, result in true stricture.

	Keyes.	Thompson.	Total.	Per cent.
Within 1 year . . . . .	121	81	202	54
1 to 5 years . . . . .	38	41	79	21
6 to 10 " . . . . .	27	22	49	13
11 to 15 " . . . . .	7	20	27	7
16 to 20 " . . . . .	8	0	8	5
21 to 30 " . . . . .	9	0	9	
Over 30 " . . . . .	2	0	2	
	<hr/> 212	<hr/> 164	<hr/> 376	<hr/>

It will be noted that Thompson's cases, founded upon pathological observation, average a much earlier onset than ours, founded upon clinical data. Doubtless his figures are the more correct.

**The Initial Symptom.**—We have tabulated the initial symptom of 422 of his cases with the following result:

Chronic urethral discharge . . . . .	238
Obstruction to urination . . . . .	77
Frequency of urination . . . . .	53
Acute complete retention of urine . . . . .	31
Pain . . . . .	8
Peri-urethritis . . . . .	7
Hemorrhage . . . . .	3
Overflow from retention . . . . .	2
Persistent chordee . . . . .	2
Epididymitis (symptoms of) . . . . .	2
Pyonephrosis (symptoms of) . . . . .	1

This list will bear various interpretations. It suggests among other things that some patients are far more alert to observe their symptoms than others; that the symptoms of catarrh usually antedate those of obstruction; that the obstruction may come on so gradually as not to fix the patient's attention until it has become complete or until the hemorrhage from an ulcer, or the pain and fever from a secondary infection of kidney or epididymis, clamor for relief.

*Chronic Urethral Discharge.*—The chronic urethral discharge of stricture (commonly called gleet) is usually little more than a drop of pus at the meatus in the morning. By the time definite stricture develops, gonococci are likely to have disappeared and been replaced by other bacteria. The urine passed always contains shreds, and these are usually of considerable size. These shreds are derived from the inflamed or ulcerated surface of the stricture and the adjacent portions of the urethra.

The presence of free pus enough to cloud the urine depends upon a superadded urethritis, prostatitis, or infection of the upper urinary tract. It should be borne in mind that large shreds are suggestive of stricture, while free pus in the urine is to be referred to the inflammation accompanying stricture.

*Frequent and Obstructed Urination.*—As the stricture grows tighter the act of micturition requires more effort and the last drops of urine dribble away. Chronic urethritis is kept up and this inflammation extends to the prostate. The resulting irritation and infection of the prostate, bladder, and kidneys cause *frequent and painful urination*. These symptoms are by no means pathognomonic of stricture. Indeed, the dysuria due to infection may quite overshadow the sense of obstruction due to stricture.

Changes in the shape or the force of the urinary stream may be due to so many conditions other than stricture that they deserve no special notice. The split or deflected stream is usually due to a drop of mucus in a tight meatus. The shape of any stream is imparted to it by the nozzle from which it flows.

*Acute Retention.*—Acute complete retention of urine (sudden complete—or almost complete—occlusion of the urethra) is due to the sudden congestion of a canal already partially obstructed by stricture. This congestion is similar to the like condition complicating prostatic retention, and is attributable to like causes, *e. g.*, voluntary retention of urine, alcoholism, exposure to cold, etc. Though the stricture is usually

very tight, I have seen cases of acute complete retention of urine due to stricture that readily admitted a 20 F. sound. Moreover, it is a commonplace observation that the patient whose stricture is so tight that no instrument can be passed through it may yet retain his ability to urinate, refuse further treatment, and go several months or years before acute retention occurs.

The retention due to stricture differs in one most important particular from that due to prostatism. Either condition may cause acute complete retention, but partial retention is not caused by urethral stricture unless that stricture is complicated by some form of prostatic retention, such as prostatic abscess or stricture at the neck of the bladder. Hence, the kidneys of a patient with stricture defy neglect in spite of repeated attacks of acute complete retention for a much longer time than those of the victim of prostatic retention. For the strictured urethra, if it permits the bladder to empty at all, permits it to empty completely. A large proportion, perhaps a majority, of attacks of acute retention with stricture are relieved almost spontaneously. The patient at first vainly struggles to urinate. If inexperienced, he promptly becomes panic-stricken and increases his agony by struggling to overcome what is for the moment an insurmountable obstacle. The torturing spasms recur every few moments until a physician brings relief, or the spasm relaxes and a dribbling, hesitating stream gradually relieves the retention. (The third possible alternative, viz., death by exhaustion or rupture of the bladder, I have never seen.)

The experienced victim, on the other hand, recognizes the thin stream that foretells retention and takes his precautions accordingly. He restrains his efforts to urinate, lies down, takes a hot hip-bath, and so often wards off the attack. Yet these palliatives sometimes fail, and he, too, has to summon professional aid.

The recurrence of acute retention depends more on the accident of congestion than the tightness of the stricture. Most patients who have had complete retention may look for repeated relapses at intervals of a few weeks or months unless they submit to dilatation. But exceptionally they escape for an extraordinary length of time. Thus, I have records of one patient who had but three acute retentions in eight years, though never dilated. Another had a single retention (undilated) ten years before he came for treatment. A third, discouraged by the failure of any instrument to pass his stricture, consulted no physician and had no retention for fifteen years thereafter. But such reprieves are neither to be expected nor to be desired. During these years the destructive effects of renal retention and infection progress silently but steadily.

*Hemorrhage.*—Apart from the bleeding excited by instrumentation, or resulting from acute prostatitis, hemorrhage is a rare symptom of stricture. It is likely to occur early, to be quite profuse, to assume the form of urethrorrhagia (hemorrhage between the acts of urination), with more or less hematuria. The bleeding during urination is likely to be terminal (most marked toward the end of the act). This bleeding, like that of fissure in ano, is due to ulceration, and is promptly

and brilliantly controlled by dilatation. The passage of a single sound may promptly control profuse hemorrhage. Such hemorrhage was noted three times as the initial symptom, and in four other of our cases as a striking symptom.

*Sexual Symptoms.*—The sexual deficiency, the impotence, the neurasthenia, and the various pains radiating from the prostate and seminal vesicles, that were attributed by a preceding generation to urethral stricture, are much more commonly seen in patients who have no stricture whatever, and are themselves rarely directly referable to stricture. Tight stricture does, indeed, often cause inflammation of the coliculus, the prostate, or the vesicles such as will interfere with their function; but it is rare that these symptoms should not be relieved by dilatation of the stricture.

*Pain.*—Various types of pain result from stricture: Painful urination has been alluded to. Painful erection amounts practically to chordee in some cases of extensive stricture in the region of the penoscrotal angle if accompanied by considerable inflammation. Perineal and other pains are due to the accompanying or resulting inflammations of the internal sexual organs.

**Complications of Stricture.** — *Prostatitis and Vesiculitis.* — These complications are so common as to be almost part of the usual clinical picture of the disease.

*Renal Retention and Infection.*—We have already insisted that the silent progress of renal infection, sclerosis and dilatation, is the most insidious and dangerous complication of stricture. It is the cause of urethral chill and urinary septicemia (whether or not excited by the passage of instruments), and of almost all the deaths resulting from the stricture itself or from its treatment. Unnumbered lives are shortened through reduction of renal efficiency. Even though the stricture itself be properly controlled, the resulting renal lesion permanently impairs the resistance of its host to such hardships, accidents and maladies as he may encounter.

No statistics can convey the precise importance of these secondary renal lesions. The least we can do is to be always on the alert, to include them in our diagnosis, and to make allowance for them in our treatment.

*Peri-urethritis and Prostatic Abscess.*—Peri-urethral phlegmon and suppuration either at the site of stricture, or arising from the prostate or Cowper's glands, was noted in 52 of our cases. The course and treatment of these complications do not materially differ from those described as complications of gonorrheal urethritis (p. 304).

*Epididymitis.*—Infection of the epididymis, as a result of urethral stricture, is usually the work of the bacillus coli or of the pyogenic cocci. Hence it is much more likely to suppurate than is gonorrheal epididymitis. Although this complication discourages urethral instrumentation, it may nevertheless be imperative to relieve a tight stricture, even in the presence of an acutely inflamed epididymis. Under such conditions the complication may sometimes prove an argument whereby

the surgeon may persuade the patient to submit to perineal section together with drainage of the epididymis.

*Other Complications.*—Among the rarer complications noted in our cases, we may mention 2 cases of prostatic stone, 3 of bladder stone, and 2 of stone in the kidney. Rheumatism was only once noted. One would fancy its actual frequency much greater than this.

*Complications Due to Treatment.*—Among the most important complications of urethral stricture are those resulting from improper treatment. Too great brutality in passing instruments may result in added scar, urethral chill, urinary septicemia, epididymitis, peri-urethritis, prostatic abscess. Failure to enter the stricture may result in false passage and peri-urethritis. Enthusiastic internal urethrotomy may result in permanent incurvation of the penis, of which 5 cases appear upon our list.

*Course and Prognosis.*—Inasmuch as the clinical picture of gonorrheal urethral stricture is a composite of scar and inflammation, more or less controllable by treatment and subject to the vicissitudes of intercurrent gonorrheas and other sources of irritation, it is obviously quite impossible to compose a picture that shall adequately represent the usual course of this disease. Slight chronic urethral discharge may be for many years the only symptom, while yet again it may be absent altogether, and only the large shreds in the urine suggest the presence of stricture. Retentions may be frequent and rapidly recurrent. Yet exceptionally a single retention, relieved without any real treatment of the stricture, may be followed by an interval of years before retention recurs. Perhaps the interval between the appearance of symptoms suggesting stricture and the beginning of treatment, will hint, as well as figures can, how various is the progress of this malady.

We have tabulated the time at which treatment was begun in 285 cases.

	Cases.	Per cent.
Within six months . . . . .	68	32
From six to twelve months . . . . .	22	
During second year . . . . .	27	36
“ third to fifth year . . . . .	77	
“ sixth to tenth year . . . . .	39	
“ eleventh to twentieth year . . . . .	39	
Beyond twentieth year . . . . .	13	4

Yet in all this uncertainty there is some regularity of prospect which may be sketched as follows:

The progress of stricture is measured by the promptness and intensity of its onset on the one hand, opposed by the efficiency of treatment on the other. Thus a stricture that has for its only symptom a mild gleet, or that begins many years after the last gonorrhea, is likely to be a slight scar, to contract slowly and may perhaps be neglected with impunity for a considerable period. On the other hand, a stricture that begins early and with symptoms of obstruction or retention is likely to be a dense scar and to progress rapidly.

Furthermore, acute retention of urine, whether relieved by dilatation or not, usually recurs within a year, if the stricture is neglected.

Strictures of the pendulous urethra contract more slowly, and even when neglected, to a less degree than those in the bulb. Yet (as we shall see) strictures of the bulb are far more amenable to dilatation than those of the anterior urethra.

Although in the absence of intercurrent gonorrhea acute prostatic or renal suppuration are rarely seen before the stricture has become very tight, peri-urethral phlegmon and suppuration may result from a stricture of relatively large caliber.

**Cure.**—Inasmuch as stricture is scar, it cannot be cured. Inasmuch as it is a constricting scar, it may be cured if the constriction is sufficiently dilated to overcome the tendency to recontract, and so long as intercurrent urethritis does not excite further scar formation, thus inducing recontraction.

Since an alleged cure of stricture must be surrounded by so many conditions, it is impossible to assure any patient with absolute certainty that his stricture will never recontract. But in this matter the distinction between stricture of the bulb (Thompson's region III) on the one hand and stricture of the pendulous and scrotal urethra (Thompson's regions I and II) on the other is striking.

The deeper strictures, though they can often be readily dilated, show an almost universal tendency to recontract. A fully dilated stricture is likely to recontract to the point of giving retention in from one to five years. Exceptionally the recontraction is slow, so that even ten to fifteen years later a small sound can still be passed, while most exceptionally the stricture does not recontract at all. At least I have followed several cases for more than ten years that showed no evidence of recontraction.<sup>4</sup>

Stricture of the bulbous and scrotal urethra, on the other hand, if it has once formed a dense scar, is very rebellious to dilatation; but when cut to no larger size than 32 or 34 F. may usually be kept widely dilated by the passage of sounds, and if this treatment is continued until the cut has healed and the adjacent urethritis is cured, no further recontraction of such a stricture need be feared. It is not to be forgotten, however, that such strictures are often accompanied by stricture of the bulbous urethra. This shows the usual tendency to recontract.

**Diagnosis.**—The diagnosis of urethral stricture must include the diagnosis of chronic anterior urethritis and of such complications as peri-urethritis, prostatic abscess, renal infection and retention, etc., since the presence of these materially influence the prognosis and treatment.

Moreover, the diagnosis of stricture itself contains an element of prognosis; for one must determine not only whether actual stricture exists, but whether stricture is likely to occur, or, if previously existing and under control, to recur.

History and urinalysis are of value in the correlation of diagnosis. But for a precise diagnosis we depend upon the examination of the patient.

**Asepsis and Anesthesia.**—The diagnosis of stricture is made by the introduction of instruments into an inflamed canal. Among the most

important results of stricture are pyelonephritis and pyonephrosis. The capacity of infected kidneys to withstand shock may be gravely impaired, though the patient may appear in smiling health. The passage of sounds is peculiarly qualified to excite an acute suppurating nephritis. Therefore the precautions elsewhere laid down for urethral asepsis and antisepsis must be most minutely observed. Instruments must be passed with the greatest gentleness, and it is actually a measure of precaution to precede the passage of urethral instruments by an injection into the urethra of 1 per cent. novocain solution, to be retained at least 15 minutes before the instruments are introduced. This is grateful to the patient, for it diminishes his pains; and it should be taken advantage of by the surgeon. He should be more than gentle. It lessens the spasm of the urethral muscles, makes the passage of instruments mechanically much easier, and diminishes the subsequent reaction.

*The Urethroscope.*—The urethroscope which is so useful for the precise diagnosis of chronic anterior urethritis may also be employed for the diagnosis of stricture. The straight open-end tube should be used. If the stricture is large enough to admit the tube, the urethral wall is seen to be rigid in that it does not fall together into the usual radiating folds. Indeed the scar, if dense, holds the urethra relatively open on the end of the urethroscope. The surface of the mucous membrane is usually inflamed, eroded and even ulcerated, most markedly at the point of stricture and to a less degree both before and behind this. If the surface inflammation is under control, however, the mucosa looks shiny, whiter than normal and quite bereft of its usual folds.

The tight stricture which will not admit the urethroscopic tube usually bleeds so freely that the examination is of little value.

*The Olivary Bougie.*—This is the favorite instrument for the diagnosis of stricture. With a complete set of bougies (from 6 to 26 F.) one may diagnose with accuracy the size of the various constrictions in the anterior urethra. Filiform strictures elude precise diagnosis by the bulbous bougie, but all other constrictions are perceptible as bands through which the bulb of appropriate size slips with a jump.

The urethrometer of Otis theoretically gives the most accurate picture of urethral constrictions. I have never employed it.

*Sounds and Bougies.*—The urethroscope gives a picture of the surface lesions of the canal. The bulbous bougie gives precise information as to the tightness of each stricture band. The sound and the bougie do not give such precise information, but they do tell us that stricture does or does not exist. They inform us as to its approximate diameter and dilatability. They are the instruments with which most of the treatment is to be conducted. For these reasons I have not used a bulbous bougie for many years. The urethroscope I employ solely for the diagnosis of urethritis. I depend upon sounds and bougies for the diagnosis of stricture.

The sound elicits the essential diagnostic sign of stricture, viz., *grasping*.

We begin our examination by passing the largest sound the meatus will admit. (Stricture of the meatus should be cut (p. 403).) This is gently introduced (p. 401) until it meets an obstacle. The sound is gently urged onward

*If it engages in a stricture*, the instrument passes onward with a distinct sense of resistance, while the patient complains of more or less pain. The maneuver at this juncture must be extremely gentle. The sound is urged onward by slight pressure and is withdrawn if the sense of resistance is extreme, or the patient's outcry considerable. If the stricture is in the bulb, the unwary operator may be misled by the fact that he can depress the handle of the sound into the belief that its point is progressing toward the bladder. To avoid this error let him watch closely the disappearance of the shaft within the meatus. The progress of the point of the sound is measured by the disappearance of its shaft.

But if the sound, thus gently introduced, progresses with no undue resistance into the bladder, the true stricture (as distinguished from purely inflammatory or spasmodic obstruction) grasps the instrument and resists its withdrawal. Any sound that will thus gently enter the unstrictured urethra will, if properly directed, fall out again by its own weight. But true stricture grasps the sound, which can only be withdrawn by force. Indeed, the effort to withdraw the instrument may be greater than that required to introduce it. This grasping of metal instruments is pathognomonic of stricture. Woven bougies are sometimes, rubber catheters often, grasped by spasm of the cut-off muscle in the unstrictured urethra.

*If the sound fails to engage*, smaller instruments are successively introduced until one enters the stricture. At or below 15 F. it is safer to employ woven bougies rather than metal instruments, and with these to continue, if necessary, until a number 10 F. fails to pass. Then we know that either the stricture is so small it will only admit a filiform bougie (a so-called filiform stricture), or else there is no stricture at all. For no final diagnosis of stricture can be made until an instrument shall have passed through and been grasped by the scar.

Suggestions of the presence of stricture other than this are indeed many. The patient's history or other physical signs may point to stricture. The sounds which fail to pass may be interrupted before their points have settled well into the bulbous portion of the urethra. The most gentle manipulation may produce profuse bleeding. Such signs point to stricture; but they do not infallibly prove its existence.

If all but filiform instruments fail, a few attempts may be made with these. But this tentative sounding may so bruise the stricture that even a filiform will not find its way in. It is therefore wiser to defer any serious attempt at passing a filiform until the following day. Then we may resume the examination, beginning with the passage of filiforms.

Some emergencies, *e. g.*, an acute retention of urine, do not permit delay. The diagnosis of stricture must be combined with the relief of retention. Under such circumstances it may be wiser to begin at once with filiforms, since these are so much more likely to enter the stricture

if no previous instrumentation has been attempted. The manipulation of filiforms is described in reference to treatment (p. 400).

After the diagnostic instrumentation the urethra should be cleansed with the routine antiseptic irrigation or instillation, preferably an instillation of 1 to 1000 silver nitrate solution.

**The Diagnosis of Impending Stricture.**—Of even greater importance and delicacy than the diagnosis of existing stricture is the diagnosis that stricture is about to occur. Yet it is only by correctly diagnosing such a condition that effective treatment can be employed; treatment calculated to cure.

Impending stricture should be suspected in every case of chronic anterior urethritis. Intelligent treatment with the Kollman dilator will lead to the resorption of those inflammatory exudates that cause urethritis and form the origin of the scar that would subsequently form stricture.

An even more delicate diagnosis is that of prospective relapse of stricture in a strictured urethra that has been fully dilated. This topic is the most fascinating part of the treatment of stricture, and is there discussed.

But if the patient has been treated elsewhere, and one does not feel sure that he ever had a true stricture, the diagnosis of a possible recurrence should be deferred for a year. At the end of this interval without treatment, if the urethra readily admits a full-size sound and the urethroscope shows no important sclerosis of the wall of the canal, the patient may safely be dismissed as free from the prospect of relapse.

**Treatment.**—The treatment of gonorrheal stricture may be preventive, palliative or curative.

**PREVENTIVE TREATMENT.**—The preventive treatment of stricture begins long before the stricture. Its foundation is a discreet management of acute gonorrhea; for a gonorrhea thus managed should leave behind little or no trace of its passage in the form of peri-urethral exudate. Just as the breaking of chordee, the use of cauterizing injections, too much zeal in the passage of urethral instruments, etc., are causes of gonorrheal exacerbations and complications, so gentleness and discretion eliminate these causes and prevent stricture.

Once chronic anterior urethritis has been established, the treatment of this, and especially the treatment with the Kollman dilator, is calculated to cause resorption of the exudate before it forms the dense peri-urethral scar which we call stricture. For even though the foundations of this scar are laid down by acute attacks of gonorrhea, the scar itself may be very slow to form, and still slower to show any perceptible tendency to contract.

**PALLIATIVE TREATMENT.**—The palliative treatment of urethral stricture consists in dilatation. From what has been said in discussing the progress of stricture, it will be readily understood that dilatation may occasionally cure a stricture. But, the prime object of dilatation is to control stricture, not to cure it. No amount of stretching can banish

a scar from the urethral wall. So long as the scar is there it is likely to recontract. The physician, therefore, will be well advised to consider his dilatation purely palliative.

*Antisepsis and Anesthesia.*—The most rigorous asepsis of instruments, patient's urethra and physician's hands should be practised as a matter of routine. But, inasmuch as the patient's urethra cannot be cleansed of the bacteria that lurk within its glands, the two essential elements to prevent complications are:

1. *Extreme gentleness* in the passage of all urethral instruments, whereby the urethral wall is spared and the foci of infection within are not stimulated to activity.

2. *Antisepsis*; preferably by an instillation of silver nitrate (1 to 1000) after the passage of instruments. This may often be properly supported by the administration of hexamethylenamin, 1 gm. twice or three times a day, for two days preceding the operation.

The anesthesia produced by filling the anterior urethra with 1 per cent. novocain for 15 minutes before the passage of instruments may be employed for each dilatation. But, though this is extremely useful to gain the patient's confidence for the first dilatation, its routine use tends to encourage brutality in the passage of instruments into the urethra and is rather to be discouraged. It is usually quite possible after a few treatments to proceed with dilatation without any local anesthetic. Indeed, the patient may not note the omission.

*DILATATION.—Instruments Required.*—A complete equipment of dilating instruments includes filiform bougies and followers, woven bougies, conical sounds and dilators.

*Filiforms and Followers.*—The filiform bougie should have a smooth, rounded, olivary point and a flexible neck, which can be temporarily bent at any required angle. One should possess instruments whose tips vary considerably in size.

Filiforms are made in two types. The one, a whalebone instrument to be used with a tunnelled sound or catheter; the other, a woven instrument, to the butt end of which is affixed a screw, whereby it can be screwed to a following sound or catheter. I much prefer the latter type. It has a more flexible point which can be set at an angle by a drop of collodion. Its screw junction with the following instrument is, of course, much smoother than that of the whalebone-tunnelled combination. But the woven instruments are relatively destructible, and can, therefore, not be employed in hospitals or dispensaries under ordinary circumstances.

Filiforms are sometimes made with their points set in curious cork-screw shapes; these have no advantage. The point of the filiform should be a little offset from its centre; so that, after it has been introduced as far as the face of the stricture, it may be revolved to make its point search over a limited area for the orifice. Any complicated angulation is wasted.

*The followers* for whalebone filiforms are made of metal. The screw instruments for the woven filiforms are themselves woven. A complete

set runs from 10 to 20 F. One should possess catheters, as well as sounds, of this description.

*Woven Bougies.*—With the filiform and its followers the stricture can be conveniently dilated to 10, 15 or even 20 F., though it is preferable to use woven olivary-tipped bougies, after the first passage of filiform and follower. A set of bougies runs from 10 to 22 F. Bougies weighted with shot, or with a lead core, are rather preferable; since their weight makes them dilate the stricture somewhat more forcefully.

*Sounds.*—When skilfully manipulated, the conical steel sound actually causes less pain than the woven bougie. But the sharp point of a small-sized sound is so likely to catch in the urethral wall that, as a general rule, one employs woven instruments up to size 20 F., and sounds from this point to the limit of the meatus. I rarely employ a sound larger than 29 F.

On the other hand, the fixed curve of a steel sound makes it an admirable instrument for entering the orifice of a tight stricture in the bulbous urethra. I have not unfrequently entered a stricture with the 10 or 12 F. steel sound, the orifice of which I could not locate with the filiform. But the maneuver is so difficult that it should only be attempted by the skilled practitioner; the uninitiated will inevitably drive the sharp point of a small sound into the urethral wall.

*Dilators.*—For sizes larger than the meatus will admit, the dilator should be employed. All modern dilators are modifications of the Kollman instrument. I have never employed an instrument with an irrigating attachment, or one that dilates only a portion of the urethra. The model I employ has a Beniqué curve, and is made to dilate the whole urethra. Here, again, I differ from the opinion of those who consider that precise treatment requires dilatation of only the strictured point. I despair of such precise diagnosis. The strictured urethra is likely to be chronically inflamed throughout. The more fully it is dilated the better.

*Dilatation of Strictures at the Meatus.*—It is a waste of time to attempt dilatation of strictures of the terminal inch of the urethra. They should be cut (p. 403).

*Dilatation of the Pendulous and Scrotal Portions.*—Strictures in this region may be dilated if they have existed for a relatively brief period. But, as a rule, they do not yield to dilatation.

Under such circumstances they should be subjected to internal urethrotomy, as described below.

*Strictures of the Bulbous and Membranous Urethra.*—These, the most common of gonorrheal strictures, yield most admirably to dilatation. Unless complicated by trauma or peri-urethritis they can, as a rule, be controlled for an indefinite period by the intelligent passage of sounds. Yet even here urethrotomy is called for when dilatation fails.

*The Technic of Dilatation.*—Let us suppose a stricture in the bulbous urethra that will admit only a filiform instrument. By describing the series of treatments whereby this is fully dilated we shall cover the whole ground.

The diagnosis has been established by vain attempts to pass larger instruments. We now resort to filiforms.

After the preliminary asepsis and anesthesia we select a filiform, bend its tip a little eccentrically, and introduce it slowly into the urethra. It catches here and there, whereupon we withdraw it, rotate the point to one side, and so pass the obstacle. If we are fortunate the filiform passes the stricture readily, but usually it is obstructed. It will not engage in the stricture. Then it must be patiently and gently moved up and down, turning the point now to the right, now to the left, but searching for the orifice of the stricture rather toward the roof of the urethra than toward its floor. If the point of the filiform finally slips into the stricture, it may be obstructed by catching in the utricle or some pocket of the posterior urethra. That the filiform has passed the stricture is recognized by estimating the depth to which it has penetrated in the urethra. That it is caught in the posterior urethra is verified by a finger in the rectum pressing against the membranous urethra. The filiform is gently moved to and fro until the pressure of the finger makes it ride out of this obstacle and into the bladder. Then the follower is screwed or slipped onto the filiform and gently pushed into the bladder.

The filiform is not so sure a guide as might be imagined; it will buckle, and even break, if the follower is pushed in with too great haste. The size of the follower should vary with the age and density of the stricture. If the stricture is thought to be but a single band, and the scar so slight that no definite irregularity can be felt in the perineum at the point of stricture, one may sometimes advantageously employ a follower as large as 14 or 16 F. But if the scar is an ancient indurated mass, the first instrument passed should be no larger than a 10 F., and it is often wiser to attempt no further dilatation until several days later.

The operation is followed by the customary instillation of silver nitrate, the instillator being placed as accurately as possible, in the hope that some of the solution may pass into the posterior urethra.

*If the filiform fails to enter the stricture*, several alternatives present themselves: The instrument may be withdrawn and tried again, after a different angle has been given to its point; or filiforms with larger or smaller bulbs may be tried; or one may fill the urethra with filiforms, and push in first one and then another, in the hope that one of them may enter the stricture.

If these maneuvers fail, and if the stricture is a relatively narrow band down to the face of which a urethroscope can be introduced, one may attempt the passage of filiforms through the urethroscope guided by the eye. Young speaks highly of this procedure, but I have had no success with it.

In quite a number of instances, having failed to introduce a filiform, I have succeeded in passing a 10 F. steel sound (with the Van Buren curve); but this instrument must be employed with the greatest imaginable gentleness, otherwise the sharp point of the sound will perforate the scar and produce a false passage.

Even after failing with all instruments, the operation should be followed by an instillation of silver nitrate against the face of the stricture. If no complications ensue, the gentle attempt to pass instruments may be repeated day after day for several days, until the patient's and operator's patience are exhausted. But the appearance of any complication, such as fever, retention, or peri-urethritis, calls for immediate operation.

In the absence of such complications there is no limit to the number of attempts that may be made to pass a stricture with filiform, but it is probable that the patient's interests will be best served by prompt operation after the failure of two or three attempts at instrumentation.

But before this final decision is reached the physician should once again try to pass a 20 F. sound into the stricture to be sure that, after all, this cannot pass. Thereby he will be saved the mortification later of passing a sound after the anesthetic has been administered.

When a filiform finally has been passed, after many fruitless efforts, one is tempted to tie it in to act as a guide for further dilatation. There is no objection to this, but unless the stricture is particularly complicated, or unless all followers have failed to pass, the tying in of a filiform is a waste of time.

*Subsequent Dilatation.*—If the stricture has been satisfactorily dilated by filiforms and followers, no further attempt at instrumentation should be made (unless retention demands it) until the fourth or fifth day; then the same procedure as before should be followed, the first instrument used being chosen with relation to previous experience. At this second instrumentation it is prudent not to attempt to dilate the stricture much wider than at the preceding sitting. Thus, if the first dilatation was to 10 or 12 F., 10 or 12 F. may again suffice, for the object of dilatation of a very tight stricture is to iron out its irregularities rather than to dilate it rapidly. By the third or fourth treatment these irregularities are usually sufficiently smooth to permit dilatation to proceed more rapidly.

The ideal interval is from five to seven days, for time must be given to the surface of a stricture to recover from the trauma of one instrumentation before a second is attempted. The rapidity of dilatation is, of course, never twice the same; but if the stricture yields rapidly, one need not fear to advance as much as five to ten numbers on any one occasion. Each sitting is begun with the passage of an instrument at least one or two sizes smaller than the largest instrument that has been passed. If this fails to enter one may have to return to the smaller instrument—to begin all over again, as it were. If it enters and is rather tightly grasped the next sound to be passed should be but one size larger. But if the first instrument is not tightly grasped, one may skip several sizes, sometimes three or four, with advantage. It is much wiser not to pass more than three sounds on any one day. These should be passed with the utmost gentleness; and while it is not quite true that they should enter by their own weight, they should very nearly do this.

There is no advantage in leaving the sound within the grasp of the stricture for more than a moment. Each treatment is concluded with an instillation of silver nitrate.

Bougies are used up to about 20 F.; sounds to the limit of the meatus; dilators to the full size, which should be 30 F. or a little higher.

After the stricture has been so dilated that the dilator enters readily and can be screwed up to 30 or 32 F. without being tightly grasped or without exciting hemorrhage, the interval between instrumentation is lengthened from one to two weeks; then to a month; to three; to six months on condition that the stricture shows no tendency to recontract. Thereafter the dilator must be introduced to celebrate New Year's day and the Fourth of July for the rest of the patient's life, if the stricture is in the bulb.

The more intelligent type of patient may be instructed how to boil his sound and to wash his hands and penis and to introduce a full-sized sound. Although there is less danger of urethral chill following the gentle and cleaner passage of a sound by a surgeon, if that instrumentation be followed by the instillation of silver nitrate along the urethra, yet it is so contrary to human nature for any man to return year after year for treatment, that it seems fair in many instances to entrust the sound to the patient. If at any time he fails to introduce the instrument he must, of course, appeal for professional aid.

**Operative Treatment of Stricture.**—*Indications for Operation.*—The failure of dilatation is the only excuse for operation upon urethral stricture. This failure may be of several kinds. Thus stricture of the meatus can never be dilated; we know beforehand that dilatation will fail and we operate accordingly.

Stricture of the pendulous urethra is amenable to dilatation only when the scar has not become fully organized. Tight stricture, or dense stricture, or stricture that is palpable, as a thickness of the corpus spongiosum in the pendulous urethra, may be dilated up to a certain point, but must be cut in order to be cured.

Stricture of the bulbous urethra, on the other hand, if of gonorrheal origin and not complicated by retention or peri-urethritis, may usually be controlled by dilatation. But if the stricture cannot be dilated, or if it persistently relapses in spite of intelligent treatment, or if retention or infection of kidney, prostate, or peri-urethral tissue require drainage, which dilatation does not afford, then operation (external urethrotomy) is indicated.

It is the part of wisdom to err on the side of operating too early rather than too late. Peri-urethritis always requires operation, and a stricture that remains impassable or proves rebellious in the course of dilatation should be operated upon as soon as the patient's consent can be obtained.

*Choice of Operation.*—For strictures of the meatus, meatotomy. For strictures of the pendulous and scrotal urethra, internal urethrotomy upon the roof of the canal. For strictures of the bulbous urethra, external urethrotomy.

*Choice of Anesthetic.*—For meatotomy or internal urethrotomy local anesthesia suffices after a preliminary hypodermic injection of morphin. A solution of 1 per cent. novocain, containing 1 drop of adrenalin (1 to 1000) to every 2 c.c. of solution, is injected into the anterior urethra and there retained for twenty minutes. This gives ample anesthesia for any internal urethrotomy.

The choice of anesthetic for external urethrotomy is still a subject of much discussion. The basis of the discussion is the difficulty of determining (by phenolsulphonephthalein or any other test) the precise condition of the patient's kidneys. The stricture that requires operation is usually an ancient one and may have impaired the kidney function far more than is suspected. For this reason perineal section, casually performed, has an extremely high mortality. But if the danger of renal death is borne in mind and the patient with urethral stricture submitted to the same careful examination and preliminary treatment as is the candidate for prostatectomy, the question of anesthetic will be solved along similar lines. Local anesthesia by means of novocain and adrenalin within the urethra, as for internal urethrotomy, aided by massive infiltration of the perineum behind the point of operation with 0.25 per cent. novocain (and adrenalin) solution, covers the field excepting only the posterior urethra and bladder neck. But the sensitiveness of these is impaired and does not occasion either operator or patient any grave inconvenience.

I have also employed sacral anesthesia with varied success, and spinal anesthesia in many instances with no mishaps.<sup>5</sup>

Gas and oxygen is the anesthetic of choice in many instances; perisacral anesthesia I have not employed.

*MEATOTOMY.*—The straight, blunt-pointed bistoury is the best instrument with which to cut the meatus. We need also several sounds to measure the resulting caliber of the urethra.

The end of the patient's penis is washed with soap and water, the field of operation anesthetized by inserting a piece of cotton soaked in 1 per cent. novocain (adrenalin) solution. After this has been in place twenty minutes it is removed, the bistoury inserted into the urethra, well within the second meatus, the head of the penis compressed very tightly from side to side, and the knife quickly withdrawn, cutting the floor of the urethra to the required depth. Only the experienced operator can expect to achieve the desired result with a single stroke of the knife. The tyro should cut too little rather than too much, and should remember that the internal meatus at the depth of about 1 cm. is often tighter than the orifice itself. A 28 or 30 F. sound is immediately introduced. If this will not pass readily, further cutting is required.

If adrenalin has been employed the after-bleeding is usually slight. No suture or cauterization of the wound is worth considering. But gentle lateral compression should be made until the bleeding stops. Then a large dressing should be applied with a penis bag and the penis held against the groin with a jock-strap or bandage. The patient is

instructed how to remove his bandage before urinating, and how to stop bleeding by lateral compression of the glans penis. He is seen daily and the wound kept open by the passage of a probe. No further attempt to pass a sound should be made until a week has passed, and thereafter a sound about two sizes smaller than the one originally passed should be introduced often enough to keep the urethra open until it has healed; this always requires at least two weeks.

*Complications.*—I have never seen any complications other than bleeding follow meatotomy. The control of the bleeding may be entrusted to the patient himself unless his mental or social circumstances are such that it seems wiser to make the operation a formal one and keep him in bed for a day or two under the care of a nurse.

*INTERNAL URETHROTOMY.—Instruments Required.*—Of the many types of urethrotomes the Otis is the best suited for those strictures that will admit it, while tighter strictures may be cut by the Maison-neuve. Appropriate sounds to measure the resulting urethral caliber and an indwelling catheter may be needed.

*The Operation.*—The operation may be performed under local anesthesia as described above. It is, however, unsafe to perform it in the office. The patient should be at his home or in a hospital.

Inasmuch as the urethra is inevitably infected and this infection lies largely beneath its surface, gentle irrigation of the anterior urethra to cleanse it of gross pus, and soap and water wash to the penis, fulfil the requirements of asepsis of the patient's person. Asepsis of instruments, operator and operating field is carried out as for a major operation.

The stricture or strictures have been previously located and calibrated.

In almost every instance the Otis urethrotome may be introduced. It is passed into the grip of the stricture and about 2 cm. farther, its knife pointed toward the roof of the canal. This places the dial in a very inconvenient position, yet it ensures against cutting too deeply off, a deep cut on the roof merely enters the septum between the corpora cavernosa, while a similar violation of the floor or sides of the canal would open the peri-urethral cellular tissue and result in abscess. The urethrotome is now screwed up to about 35 F. and the knife slowly withdrawn until it is felt to jump through the strictured portion of the urethra. The urethrotome is then immediately screwed down to its smallest size and withdrawn. A 30 or 31 F. sound is passed to the bulbous urethra, *but no farther*.

If at the first attempt one deems it unwise to screw the urethrotome all the way up to 35, or if after the cutting the sound does not pass freely, a second cut upon the roof may be made. The meatus may be cut by turning the instrument over and cutting on the floor at this point. If after the division of the first stricture other unsuspected points of constriction are found, these must be cut. During this whole operation no instrument has been introduced into the membranous urethra.

The surgeon now estimates the amount of bleeding. If this is slight no dressing is required other than a hood of gauze to keep the bed-covers

clean. The patient is left to urinate at will, with the assurance that since nothing has been introduced into the posterior urethra, urethral chill will not occur.

But if the bleeding following the operation is severe it is wiser to tie a catheter into the bladder: the mere presence of this instrument stays the hemorrhage in almost every instance. Any bleeding that persists may be controlled by pressure. But if much pressure is required it is wiser to adjust small splints to the dorsum and the venter of the penis, making pressure upon these, so that the penis will not be strangled in case of erection. This indwelling catheter should remain in place two to four days.

*Complications.*—The precaution alluded to excludes any danger from urethral chill or any other forms of urinary infection. The method of controlling hemorrhage has been described. Peri-urethritis as a result of overcutting I have not seen. Among over 150 operations reported in our case-books there was 1 death from pyemia.

If the stricture is too small to admit the Otis instrument the Maison-neuve may be employed. If it is impassable, perineal section is performed and the urethrotome passed from behind forward.

*After-treatment.*—If the indwelling catheter is used this is withdrawn on the second, third, or fourth day. Thereafter the patient goes about his business as usual. The first sound is passed between the tenth and the fourteenth day. It is well to begin with a woven bougie of about 16 or 18 F. size. This gently dilates the urethral wound and may be followed by a 24 or 25 F. bougie or sound. No attempt is made to pass a larger instrument at the first sitting.

Thereafter the patient returns for instrumentation every five days, and as soon as the stricture can be dilated to 25 F. without considerable bleeding, further dilatation up to 30 F. is carried on with the Kollmann dilator. As soon as the full size is reached without causing considerable hemorrhage the interval between sittings is increased to two weeks, and dilatations are continued at this interval until the wound is healed and the urethritis controlled. This will usually take about three months. The patient is then requested to return after an interval of six months. If at the end of this time the urethritis has not relapsed and the stricture has not recontracted, he may be dismissed as cured; otherwise he may require further dilatation or cutting.

*EXTERNAL URETHROTOMY WITH A GUIDE.*—*Instruments Required.*—In addition to the usual instruments, external urethrotomy requires a curved, sharp-pointed bistoury, a female catheter (preferably of metal), two or three grooved staffs of different sizes, or if the stricture is known to be too small to admit these, filiforms and tunnelled followers. The groove of all staffs and followers should be as wide as possible, so that the knife plunged into the perineum may readily find it. The familiar soft-rubber perineal tube with a lateral as well as a terminal eye is usually employed for drainage after the operation; but one should have at hand a double-current tube for continuous irrigation in case the bladder neck is so torn as to bleed alarmingly.

*The Operation.*—The operation performed by the expert when the stricture is of sufficient caliber to admit a grooved staff is quite different from that employed for a tighter stricture or by a less experienced operator.

*The Operator is Expert: The Stricture Admits a Staff.*—The patient is placed in the lithotomy position, *i. e.*, with the buttocks brought down so that they overhang the edge of the table and both hips and knees sharply flexed and supported by some form of stirrup. If the table is low the operator's comfort requires that the patient's buttocks be elevated on a sand bag.

The usual asepsis is employed.

A grooved staff is introduced into the urethra and passed into the stricture and *well into the bladder* (to prove that the instrument is not in a false passage). It is then partially withdrawn and passed to an assistant, who holds it in such a position that its groove projects in the median line of the perineum so as to be readily palpable. With his other hand this assistant pulls the scrotum up out of the operator's way. The operation is now performed with a single thrust of the knife. The curved, sharp-pointed bistoury is plunged through the perineum into the groove of the staff at a point about 4 cm. in front of the anus, where the staff begins to curve away from the perineum up toward the membranous urethra. The point of the knife is then carried backward in the groove of the staff for 1 or 2 cm. until it just enters the membranous urethra; then with a downward stroke its point is withdrawn so as to cut a hole through the urethra, the perineum and the skin quite large enough to admit the finger readily. Some practise is required to perform this stroke accurately. It is essential that the mucosa of the urethra be widely incised.

As soon as the knife is withdrawn the operator introduces his forefinger, feels for the groove of the staff, and makes sure that his finger rests against this with no mucous membrane between. Then taking the handle of the staff in his left hand he slowly withdraws this while pressing quite firmly against the groove with his finger in the wound. As the tip of the staff slips from beneath this finger it feels the roof of the canal and follows this backward into the membranous urethra and thence into the bladder. If the deeper portion of the stricture has not been sufficiently incised at the first stroke of the knife a grooved director may be introduced through the perineum and the floor of the urethra sufficiently divided with a scalpel to admit the tip of the finger, after which the remaining fibers are torn. The finger as it enters notices the presence or absence of any prostatic areas suggestive of stone, abscess, etc., and on withdrawal it sweeps the roof of the urethra to be sure there is no projecting band of stricture there. If such a band is found it is nicked or cut away.

A 30 F. sound is then introduced into the meatus and passed into the bladder. If this is obstructed, meatotomy or internal urethrotomy are performed as required.

The rubber perineal tube is then grasped by a long forceps in such a

way as to bend its tip like an elbowed catheter. It is thus readily introduced into the bladder, the forceps withdrawn, and a syringeful of 1 to 5000 silver-nitrate solution washed through the tube to make sure that it is in proper position. If the fluid fails to return, this may be either because the tube is too far in or not far enough in, or because its eye is obstructed by clots. Clots may be aspirated with the piston syringe. The proper position of the tube will be assured if the operator is careful to insert into the wound a length only a little more than that of his own forefinger.

After the tube has been properly placed it is held in by a catgut suture that catches the two edges of the wound and is wound four or five times around the tube (pins or needles stuck through the tube soon destroy it).

The patient's legs are then let down, a thick dressing applied under a T-bandage, the testicles being well supported by this; the patient is then removed from the table to his bed, and after reaching his bed the proper function of the tube is again tested. After this a large rubber tube is attached, leading over the side of the bed into a bottle.

*Precautions.*—Experience and skill are required to perform the operation in this manner. The tyro by making his first incision wrong is likely never to get his finger into the urethra, but will burrow with it outside of the mucosa which lies between him and the staff. Then on withdrawing the staff and realizing that he is lost he will fail to reinsert his guide, then he will cut through the roof of the urethra and never reach the bladder.

A precaution to be applied to every form of external urethrotomy is not to pack the urethra around the tube. The immediate profuse bleeding promptly ceases; or may be controlled by firm pressure of the external dressing against the tube. Packing about the tube is likely to excite much more hemorrhage, when it is removed a few days later, than would have occurred in the first place. Furthermore, it encourages infection and delays healing.

Some operators prefer to apply an indwelling catheter and sew the urethra rather closely about this, while leaving the skin of the perineum open. But I believe the wound heals better if a straight perineal sinus remains as left by the perineal tube.

*After-treatment.*—If there is any grave question of the kidney function this is stimulated as after prostatectomy by injection of salt solution through the rectum, forcing fluids by mouth, and fresh air. The perineal tube is usually removed at the end of twenty-four to forty-eight hours, but doubtful renal function may encourage longer drainage. In this event it is wise to replace the large tube by a smaller one, either in the perineum or through the anterior urethra, and to get the patient out of bed as much as possible.

The immediate convalescence of perineal section is likely to be stormy. The patient's temperature may rise to 103° F. immediately after operation or immediately after removal of the perineal tube. The unfamiliar operator will have great difficulties with the drainage of his tube. The

bladder will fill with urine or with clots; the patient will suffer grave agony and may even die, septic and exhausted, as a result. But experience and good nursing avoid these complications.

Clots may be sucked out of the bladder readily enough, and if the tube when placed properly does not relieve the patient's spasms, it should be removed.

While the tube is in place the bladder should be irrigated once or twice daily, preferably with silver nitrate solution.

After removal of the tube no further irrigation is attempted so long as the patient progresses satisfactorily. An immediate rise of temperature may be watched for forty-eight hours. If at the end of this time it remains up a catheter should be tied in and water forced. Under these circumstances rather high doses of urotropin are sometimes of service. Good drainage, fresh air, and forced water are our chief reliance. If all goes well no instrument is introduced into the bladder until about the twelfth day, when a 20 or 22 F. steel sound is passed into the urethra after anesthetization with novocain. If no incision has been made upon the roof of the urethra the instrument is likely to enter the bladder quite readily, but if the roof has been incised its point will catch here and need to be deflected toward the floor before it will pass the stricture.

If any real difficulty is encountered, this may be overcome either by introducing the finger into the perineal wound or more neatly by passing a grooved director from the wound into the bladder and introducing the sound on this; or else by inserting the two ends of a filiform into the wound; one toward the bladder and one toward the meatus, using this as a guide. After the introduction of the first sound but one more instrument should be passed, preferably a 25 F. sound. This is followed by an instillation of 1 to 1000 silver nitrate, the solution being trickled along the posterior and anterior urethra.

On two occasions I have seen such profuse bleeding follow the extraction of the perineal tube or the passage of the first sound that I was moved to give the patient an anesthetic, reinsert a tube in the perineum and pack around it.

The subsequent passage of sounds is made at the usual five or seven days' interval. Much more skill is required to enter the lacerated urethra than to pass any stricture. The inflammatory irregularities following operation persist for at least a month. It is wiser during the first two weeks not to attempt to stretch the urethra above 25 F. Subsequent to this the dilator should be used and the urethra opened to 30 F. The fistula should heal within two to six weeks. It requires no particular care beyond the destruction of exuberant granulations. The healing may be encouraged by swabbing the sinus with trichloroacetic acid or by touching with silver nitrate fused on a probe. If these measures fail the sinus must be excised and the perineum sutured in layers around a small tube.

*The Surgeon is Inexpert or the Stricture is too Tight to Admit a Grooved Staff.*—The operation is performed as above described except that the

staff is cut down upon widely instead of by touch and the way into the bladder is made certain by a guide inserted through the perineal wound.

With the patient in the lithotomy position a staff is inserted through the stricture, or if this will not enter, a filiform bougie is introduced, and upon this a small tunnelled staff is passed, either through the stricture or down to it. The tissues are made tense over the staff and divided in the median line, layer by layer; skin, superficial fascia, fat, muscle and then the bulb itself.

The incision of the bulb is signalled by a gush of blood which is to be disregarded. The floor of the urethra is incised just in front of the stricture, widely enough to expose the filiform and follower plainly to view. With artery clamps the divided edges of the mucosa are now seized. (The unfamiliar operator will grasp the sheath of the corpus spongiosum; this will lead him nowhere. He must seize the mucosa itself on each side.) The urethra is steadied between these clamps, the follower withdrawn, but the filiform left in place (or if a grooved staff has been employed this is not withdrawn).

The floor of the urethra is then longitudinally divided back to the point of stricture, the urethra being drawn out into the perineum by the application of successive pairs of clamps along its cut edges. When the orifice of the stricture has thus been brought into view with the filiform (or staff) disappearing through it, a grooved director is inserted in the general direction of the long axis of the patient's body (almost at right angles to the part of the urethra that has already been incised). If this grooved director is known to be in the bladder, the filiform (or staff) is withdrawn and the floor of the stricture divided by a knife introduced into the groove of the director. The finger is then introduced into this cut and guided by the director until it passes through the dilated prostatic urethra and the ring of bladder neck into the bladder cavity.

If during any part of the operation the operator becomes lost in the perineum he may usually find his way by passing a female catheter alongside of the grooved director; a gush of urine through the catheter announces that it has reached the bladder. The rest of the operation is performed as described above, with the exception that the urethra may well have been extensively damaged and require suturing, especially that part of the floor anterior to the point through which the perineal tube goes. The bulbocavernosus muscle and superficial tissue are also brought together by catgut suture so as to bury the urethra deep within the perineum and thus to minimize the prospect of persistent fistula.

**EXTERNAL URETHROTOMY WITHOUT A GUIDE.**—If after the patient has been anesthetized no sound or bougie, large or small, or even filiform, can be introduced into the stricture, about 20 c.c. of 0.5 per cent. solution of methylene blue is injected into the urethra and patiently milked through the stricture and into the bladder (I have employed this device a number of times and have never known the coloring matter not to enter the bladder unless there was an open fistula

or a large peri-urethral abscess). The excess of solution is then permitted to escape and the anterior urethra washed out with one or two injections of water, so that no excess of coloring matter shall remain to soil the wound when the urethra is cut open.

The patient is then put in the lithotomy position and as large a staff as the urethra will admit is passed to the face of the stricture in the perineum. The urethra is incised upon this as described in the preceding section, layer by layer. The mucosa is readily identified and grasped on each side by artery clamps. The staff is withdrawn. Now comes the delicate part of the operation.

The wound in the urethra and in the superficial tissues must be wide enough to permit the canal to be drawn almost flush with the perineal skin. The clamps are now steadied and the operator closely inspects the urethra, inserts the probe to its deepest point, and gently incises the floor of the urethra upon this. By the aid of further pairs of clamps the whole of the urethra and the face of the stricture are laid out flat before the operator. He now searches every corner of this surface for the orifice of the stricture with the point of a filiform bougie. It will usually be found much nearer the posterior angle of the wound (and what might be termed the lower surface of the corpus spongiosum) than would be supposed.

If the orifice of the stricture is not found the bulbocavernosus muscle is cut and stripped away from the bulb (if more room is needed the superficial tissues may be divided transversely or in V-shape). When the bulb has been freely exposed by good retraction of the superficial tissues it is deliberately cut transversely, posterior to the point where it has been divided longitudinally, in the vain search for the orifice of the stricture. At some point the blue mucosa will again be encountered and from this point the passage into the posterior urethra with filiform and grooved director is easy.

I have only once failed to find the orifice of the stricture by the longitudinal incision of the bulb. In that case the transverse incision readily disclosed it. The surgeon who should fail by either device is thereby proved so unfamiliar with the perineum that he had better make no further attempt to find the urethra at the apex of the prostate, but rather take refuge in suprapubic incision of the bladder and *retrograde catheterization* by a Beniqué sound passed through the bladder and thence into the posterior urethra. The floor of the urethra is incised upon the point of this instrument and the remainder of the operation concluded in the usual manner.

*Other Devices for Finding the Orifice of the Stricture.*—Various other methods have been employed to find the way through the stricture. Thus we may mention the Wheelhouse staff, which is no longer used, and Young's suggestion that we identify the apex of the prostate through the V-shaped prerectal incision upon the membranous urethra and work backward from this into the stricture. Any surgeon skilful enough to perform this operation could much more readily enter the stricture by the method described above.

Sinclair's device for retrograde catheterization consists of a trocar and cannula, to be plunged through the space of Retzius into the bladder, after this has been distended with fluid forcibly injected through the urethra (unless it is already distended with urine). Through this cannula a probe is introduced into the posterior urethra and up to the posterior face of the stricture. The urethra is incised upon this, the stricture divided, internal urethrotomy done, if necessary, and a soft-rubber catheter left in the suprapubic wound to drain the bladder. No perineal or urethral drain is used. The inexperienced surgeon will find it much safer to perform suprapubic section for his retrograde catheterization, for there is a distinct possibility that the trocar may enter the peritoneum.

Under local anesthesia the opening of the urethra may be found if the patient can be persuaded to urinate.

**RESECTION OF THE URETHRA.**—The urethral mucosa grows with such amazing rapidity and covers such incredibly large gaps that even when the removal of dense scar tissue about the urethra leaves a wide gap no attempt at skin grafting is necessary. Indeed, such grafts rarely take. Sections of the saphenous vein have been employed to take the place of portions of the urethra, but the epithelium does not live. The only requirement for filling a gap in the urethral wall is to fix the two ends of the urethra as near together as may be and in such a position that a sound will readily enter the posterior end, for if subsequent passage of sounds is possible, we may look for a happy outcome.

*Cabot's Resection.*—Hospital surgeons impressed by the frequency with which patients return after a few years' interval for repeated perineal sections have endeavored to devise operations whereby better results could be obtained and the stricture perhaps definitely cured. The two modern efforts to achieve this result are Marion's and Cabot's. The former is not applicable to stricture but is an excellent operation for the treatment of rupture of the urethra (*q. v.*). The aim of Cabot's operation is to divide the stricture upon the floor of the urethra in the usual manner and to reunite the longitudinal incision by transverse suture, thus puckering the urethra, as it were, and enlarging the lumen of the stricture.

The steps of the operation are as follows: The urethra is steadied by a sound instead of a staff. The bulb is exposed in the usual manner but not incised. The bulbocavernosus muscle is stripped away and the bulb itself separated from the corpora cavernosa for a space of at least 3 cm. The bulb is now opened over the point of the sound and the stricture incised in such a manner that the urethra is opened for a short distance behind as well as in front of it. Beginning at the tightest point of the stricture (*i. e.*, approximately at the middle of the longitudinal incision in the bulb) the adjacent edges of the mucosa and underlying corpus spongiosum are sutured transversely with fine catgut introduced on a curved intestinal needle. A small sound is left in the urethra while successive sutures are taken in each side and clamped, but not tied, until the whole wound has been caught in sutures running from before

backward and calculated to close the wound transversely on the sound in the urethra. The sutures are then tied, beginning with the ones first introduced and ending with those central ones that approximate the anterior and posterior ends of the original incision. Drainage is provided by a small catheter introduced into the urethra at a point posterior to the incision in the stricture. The perineum is sutured over the incision in the urethra; the small catheter left in place for two weeks; the bladder irrigated daily. Cabot advises daily gentle injection of argyrol into the anterior urethra. We have thought that the trauma from this did more harm than the antiseptics did good.

Cabot's operation is obviously only applicable to relatively narrow strictures. In seven or eight cases it has given me better results than simple urethrotomy; but the urethra is much puckered by the operation and one must be extremely gentle in the first attempts to introduce sounds.

RESECTION OF FISTULÆ, ETC.—External urethrotomy for stricture may be complicated by peri-urethritis, fistula, etc., or by masses of scar left by ancient peri-urethritis. The following rules should guide the operator, viz.:

1. The main incision should be in the central line of the perineum, no matter how many accessory incisions are required.
2. Fistulæ must be widely opened to their ultimate ramifications. A pocket in the perineum will not heal.
3. Masses of hard scar tissue must be excised, even though this sacrifice the urethral wall. But every effort must be made to leave an even roof to the urethra as a guide to sounds.
4. It is preferable, though not essential, to excise the fibrous walls of all fistulæ.
5. If the urethra has been completely divided its roof must be repaired as well as possible and its floor left wide open so that subsequent sounds may readily enter the posterior segment.
6. In order to avoid subsequent fistula the perineum must be reconstructed as well as possible.

### TRAUMATIC STRICTURE.

The urethra may be torn, punctured, or incised in any part of its course. Punctures or linear incisions (*e. g.*, false passages from rough instrumentation, tears resulting from the extraction of calculi or foreign bodies, bullet wounds, urethrotomy incisions, etc.) usually heal without leaving any stricture; for unless peri-urethritis ensues the scar occupies so small a portion of the circumference of the canal that its contraction does not appreciably encroach upon the lumen.

The types of injury likely to result in stricture are (1) the so-called straddle injury (whereby the membranous urethra is partly or wholly torn across); (2) fracture of the pelvis (with the same result); (3) prostatectomy (which may leave a stricture at the bladder neck);

(4) the Bottini operation (which may so cauterize the junction of the bulbous and the membranous urethra as to leave stricture there), and (5) injuries to the erect penis (such as breaking a chordee).

With the postprostatectomy stricture we have no concern here. Of the others it may be said that they contract much more rapidly, require operation for their relief much more often, and recur after operation with much greater obstinacy than do gonorrheal strictures. Thus, among 44 personal cases, all appeared within six months of the injuries excepting 4. Although an interval of from five to twenty years intervened in these 4 cases between the trauma and the diagnosis of stricture, each one had received more or less treatment during this interval; treatment that might have controlled the stricture in some degree. But, as a rule, traumatic stricture, from whatever cause, defies such casual treatment and contracts very rapidly. Among 28 accurately described cases I find 23 impassable or filiform in size, the other 5 had contracted to 10, 15, 17, 18 and 24 F. Of 44 cases tabulated, 31 were operated upon in our office and many others elsewhere. Obviously, traumatic stricture contracts much more obstinately than gonorrheal stricture.

**Pathology.**—The pathological changes that constitute traumatic stricture are but the scars left by the various types of ruptures in the urethra mentioned above. As Bazy has pointed out, the rupture may be so slight that only the mucosa is torn, but, as a rule, the whole thickness of the urethra has been divided in part or all of its circumference. The typical resulting scar therefore is a narrow one as contrasted with the broad, irregular scar of gonorrheal stricture; but it is a dense and elastic scar, contracting rapidly and resisting dilatation.

**Symptoms and Course.**—The chronic urethral discharge (gleet) which is the prevailing symptom of gonorrheal stricture cuts but a slight figure among the symptoms of traumatic stricture. Thus among 21 cases only 2 showed gleet as a first symptom, while 10 complained of frequent and obstructed urination, and 9 of acute retention. In many instances the stricture came on so immediately after the injury that the hematuria which is so prominent a symptom of rupture of the urethra was also the first symptom of the stricture itself. Indeed, the symptoms of stricture usually follow immediately upon those of the rupture. If the injury is so severe that the patient cannot urinate or requires attention for other injuries the urethral rupture is immediately diagnosed, the patient is operated upon, and if properly treated he may be relieved from any symptoms of stricture for a considerable time. Thus weeks, months, and exceptionally years may intervene before the traumatic stricture is diagnosed. But if the injury is only severe enough to cause slight hematuria the patient may not consult a physician, no attempt may be made to treat the condition, and always within a few weeks the stricture declares itself by obstructing urination.

The very beginning of traumatic stricture therefore depends largely upon treatment, and its subsequent course is even more dependent upon this. Operation which is not often necessary in the treatment of

gonorrheal stricture is almost invariably an essential part of the treatment of traumatic stricture. The stricture must be incised. If it recontracts thereafter it must be incised again. Thus only will its tendency to recontraction be finally overcome.

**Treatment.**—A slight injury to the urethra sufficiently severe to cause hemorrhage should at least be identified by urethroscopy and treated by the passage of sounds according to the rules already laid down. Graver injuries, including almost all injuries to the bulb and posterior urethra, require prompt perineal section and subsequent sounding as a preventative of stricture. Doubtless stricture will follow such operation, but it will be less resilient and intractable than if the operation had not been done.

For the cure of traumatic stricture internal urethrotomy for anterior strictures and external urethrotomy for stricture of the membranous urethra yield surprisingly good results. If the after-treatment is conducted for a sufficient length of time, as stated above, the failure of one perineal section is no reason why another will not succeed.

On several occasions patients have come to me in despair on account of the recurrence of symptoms or the physician's inability to pass sounds a few weeks after operation. They were promptly put in the hospital, the stricture reincised, and thereafter the case presented no unusual difficulties. Such patients I have had under control for as long as ten years. They need rather more frequent dilatation than gonorrheal patients, but they are just as controllable; and once the operative wound has healed and the stricture takes a full-sized sound its resilience is usually conquered.

### CONGENITAL STRICTURE.

Congenital narrowing of the urethral lumen may be very considerable and yet cause no symptoms. Hence the pathological condition must be distinguished from the clinical. The former must be considered first.

Englisch,<sup>1</sup> in his compendious study, has collected 155 cases of atresia and 208 of congenital stricture affecting every portion of the urethra; for although the urethra is indeed developed from three sources (the posterior urethra from the urogenital sinus, the balanitic from an infolding of skin, and the intervening anterior urethra from the penile groove) nevertheless congenital stricture may occupy any portion of the canal. It may be membranous or fibrous. A large if not a major proportion of strictures are not associated with other defects of development. The stricture is usually of no great width (in contrast with atresia which may extend over the greater part of the urethra).

The meatus urinarius and the so-called second meatus (a constriction at a depth of about 1 cm. within the urethra) are the usual site of congenital stricture. Indeed, in this region it is familiar to all while elsewhere it is extremely uncommon (I have seen less than half a dozen clinical cases).

**Etiology.**—The cause of congenital stricture is either maldevelopment or inflammation of the urethra before birth. (Englisch believes that some so-called congenital strictures are the result of non-gonorrheal urethritis in infancy, due to balanitis, masturbation, or the exanthemata.)

**Pathology.**—The stricture may be due to a valve of mucosa, to a constriction of all coats of the urethra, or to scar.

Complicating hypospadias, dilatation, and fistula are not uncommon. Tight stricture results in dilatation of the upper urinary tract similar to that which results from retention in later life.

**Clinical Types.**—1. The tightest strictures, amounting almost to complete atresia, produce enormous renal dilatations which either kill the child at about the time of birth or gravely interfere with parturition because of their size. The interest of such cases is purely pathological and obstetrical. The stricture is often found in the region of the verumontanum.<sup>3</sup>

2. If the stricture permits the infant to survive, symptoms are often first noted between the fifth and tenth years. Congenital stricture may be suspected in cases of (a) incontinence of urine, especially if this be diurnal, (b) poor nutrition associated with evidence of renal deficiency, (c) unexplained hematuria.

3. The stricture may, however, have so large a caliber that it excites no symptoms until in adult life an intercurrent urethritis calls attention to it. If the urethritis is gonorrheal the true origin of the stricture is, of course, overlooked. Bazy therefore insists that congenital strictures are much more common than we suppose.

4. The stricture interferes with the passage of urethral instruments. Most meatus strictures fall in this category.

**Diagnosis.**—This is usually made by the exclusion of trauma and gonorrhea (except in the case of meatus strictures).

It has been my good fortune to identify congenital strictures thrice by careful perineal section.

It is difficult to arrive at a clinical criterion as to the exact amount of constriction that constitutes a congenital stricture. Certainly only those strictures require attention that cause retention, interfere with the cure of urethritis or prohibit the passage of urethral instruments. Doubtless it is fair to consider any stricture tighter than 18 F. a potential, if not an actual, cause of retention.

**Treatment.**—Englisch wisely observes that "the earlier the obstacle develops, the more extended are the alterations of the urinary tract higher up." He believes that treatment by dilatation is often useful. Stricture of the meatus will not dilate. It must be cut. All the deeper strictures I have recognized have required operation.

## OTHER TYPES OF STRICTURE OF THE MALE URETHRA.

**Tuberculosis.**—Tuberculosis of the prostate very rarely results in urethral constriction. Occasionally it causes a stricture of the bladder

neck, producing frequency of urination or residual urine. This, if not organized, yields to (and its symptoms disappear following) the passage of the cystoscope. Cicatricial stricture of the deep urethra after the subsidence of the prostatic lesion requires operation for the contracture (*q. v.*).

Tuberculosis of the anterior urethra is so rare that it may be dismissed with the statement that it is usually unimportant but may require the routine treatment.<sup>8</sup>

**Syphilis.**—The scar of gumma about the meatus may cause stricture. The existence of syphilitic stricture of any importance elsewhere in the urethra is doubtful.<sup>9</sup>

**Chancroid.**—This may also leave a scar that constricts the meatus.

**Bilharzia.**—Pfister<sup>7</sup> states that stricture of the prostatic urethra may result from Bilharzial inflammation. The infection may rarely extend to the anterior urethra and even to the corpora cavernosa.

**Stone, Foreign Bodies, and Cancer** may obstruct the urethra. They can scarcely be said to cause stricture.

### STRICTURE OF THE FEMALE URETHRA.

Stricture of the female urethra, whether congenital, traumatic, or gonorrheal, merits only that its existence be known. Like stricture of the male urethra it is a cause of frequent urination, pyuria, retention. It may be relieved by dilatation or by internal urethrotomy.

### BIBLIOGRAPHY.

1. Englisch: *Folia Urolog.*, 1909, iv, 288, 376.
2. Halle: *Annal. d. urol. d. org. Gen.-Urin.*, 1891, ix, 143; 1894, xii, 244.
3. Heinecke: *Zeit. f. Urol.*, 1913, ii, No. 1.
4. Keyes: *Trans. Amer. Genito-urinary Surg.*, 1915.
5. Keyes and MacKenzie: *New York Med. Jour.*, November 9, 1912.
6. Minet: *Guyon's Annales*, 1911, i, 46.
7. Pfister: *Verhandl. d. Deut. Gesellsch. f. Urol.*, 1911, iii.
8. Sawamura: *Folia Urol.*, 1910, iv, No. 9.
9. Tauton: *Progress Méd.*, 1910, p. 607.
10. Thompson: *Stricture of the Urethra*, 1858, 2d edition, p. 84.

# SECTION III.

## DISEASES OF THE SCROTUM AND TESTICLE.

---

### CHAPTER XII.

#### ANATOMY AND PHYSIOLOGY, MALFORMATIONS, INJURIES AND TORSION OF THE TESTICLE.

By GEORGE GILBERT SMITH, M.D.

#### THE TESTICLE AND EPIDIDYMISS.

**Embryology.**—The testicles develop during the first third of fetal life. Each testis appears first as the genital ridge upon the ventromesial border of each Wolffian body (Fig. 173). Peritoneal infoldings give rise to solid cords of cells which extend inward from the peritoneal surface of the genital ridges to connect with the glomerular capsules of some of the Wolffian tubules (Fig. 174). Before reaching the glomeruli, these cords, which later acquire lumina, form a net of anastomosing tubules, which becomes the *rete testis*. Of the Wolffian tubules, ten to fifteen are utilized in this way. The glomeruli atrophy and the tubules become coiled canals which form the *ductuli efferentes* in the globus major of the epididymis. The Wolffian duct, into which they empty, persists as the *ductus epididymidis* and its continuation, the *vas deferens*. Of the Wolffian tubules not utilized in this way, one or more may persist as very small pedunculated bodies springing from the globus major or from the upper pole of the testicle. The *organ of Giraldes* or *paradidymis* is thus explained; the *hydatid of Morgagni* is said to be a remnant of the duct of Müller. (In the female the duct of Müller becomes the Fallopian tube.) One or more of the lower Wolffian tubules may persist as aberrant ducts leading off the ductus epididymidis in the globus minor<sup>23</sup> (Fig. 175).

**Descent of Testicle.**—As the testicle takes definite shape a fold of peritoneum develops, extending from the lower pole of the testis downward and outward across the iliac fossa. In the free border of this fold develops the gubernaculum, a cord of connective tissue, in which are found smooth muscle fibers, supposedly derived from the muscles of the

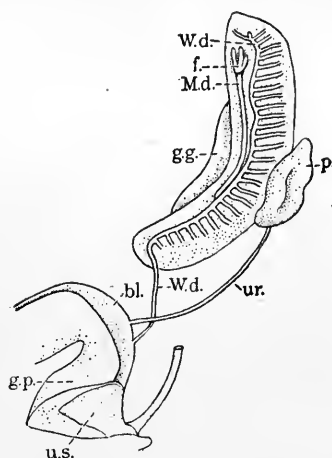


FIG. 173.—From a reconstruction of a 13.6 mm. human embryo (F. W. Thyng). *bl.*, bladder; *f.*, fimbriae; *g.g.*, genital ridge; *g.p.*, genital papilla; *M.d.*, Müllerian duct; *p.*, renal pelvis; *r.*, rectum; *ur.*, ureter; *u.s.*, urogenital sinus; *W.d.*, Wolffian duct. (Lewis and Stöhr.)

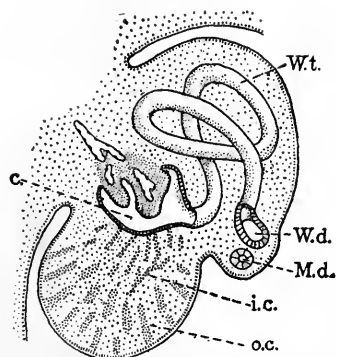


FIG. 174.—Diagram of the development of the testis, based upon figures by MacCallum and B. M. Allen. *c.*, glomerular capsule; *i.c.*, inner or sex cords; *M.d.*, Müllerian duct; *o.c.*, outer or rete cords; *W.d.*, *W.t.*, Wolffian duct and tubule. (Lewis and Stöhr.)

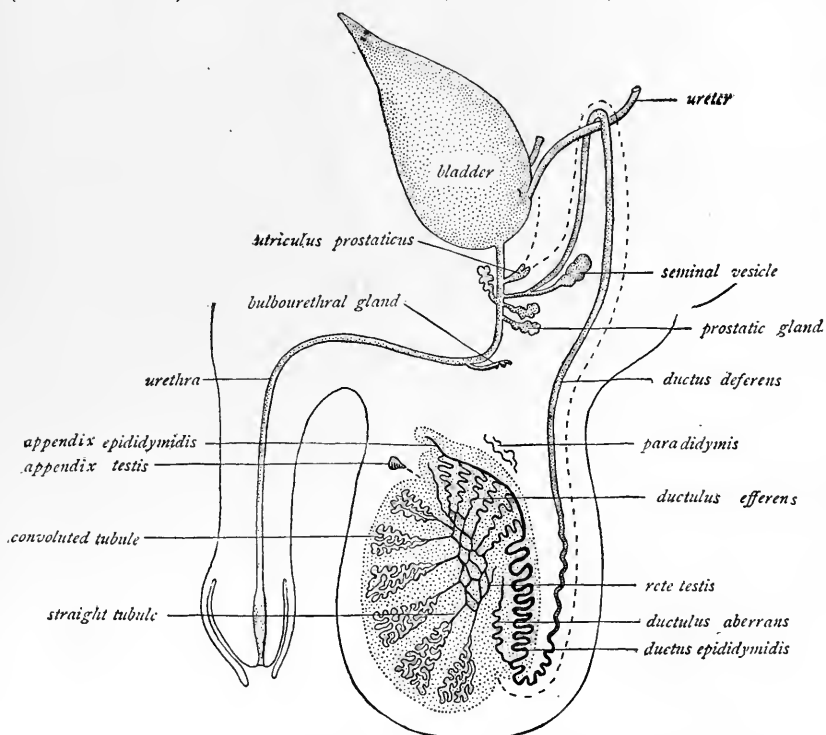


FIG. 175.—Diagram of the male sexual organs (Modified from Eberth, after Waldeyer.) The course of the Müllerian duct is indicated by dashes. (Lewis and Stöhr.)

abdominal wall.<sup>17</sup> Inferiorly the gubernaculum has attachments in Scarpa's triangle, to Poupart's ligament, to the pubic bone, to the root of the penis, to the perineal fascia and ischium, and to the bottom of the scrotum.<sup>17</sup> As the lumbar spine grows, the testicle is left behind, so to speak, and thus begins its descent. Whether further descent comes about through the same means—that is, by the body growing away

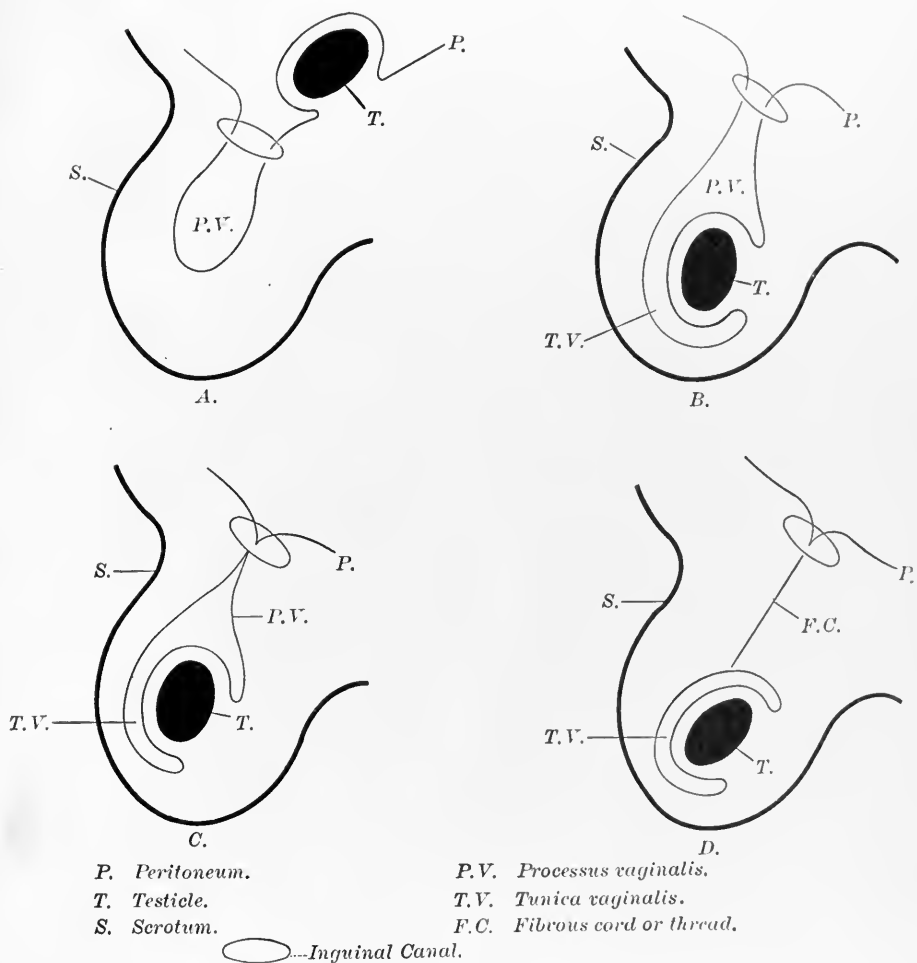


FIG. 176.—Diagram of the descent of the testicle. (Watson and Cunningham.)

from the testicle—or whether the gubernaculum shrinks and exercises an active pull is not known. The fact remains that by the sixth month the testis is at the internal inguinal ring, drawn down by the gubernaculum and connected with its place of origin by the spermatic vessels. The vas deferens, the lower end of which is now attached to the prostate, is drawn outward and downward, passing in front of the ureter and hooking over it.

During their descent the testicle and epididymis have been surrounded by peritoneum except where the membrane is reflected off the epididymis. A diverticulum of the peritoneal cavity, the *processus vaginalis*, has preceded the testis into the scrotum. The testicle enters the inguinal canal, passes out through the external ring, and at birth or shortly after reaches its position in the scrotum. The peritoneal canal then becomes obliterated in its upper part, leaving the lower part to form a serous sac for the testicle (Fig. 176).

### ANATOMY OF THE TESTICLE.

The testes are a pair of somewhat oval, slightly flattened bodies of a grayish-white color, measuring about an inch and a half in length, one inch from before backward, and rather less in thickness.<sup>7</sup> As the testicles hang in the scrotum the long axis is directed upward, slightly forward and outward (Figs. 177 and 178).

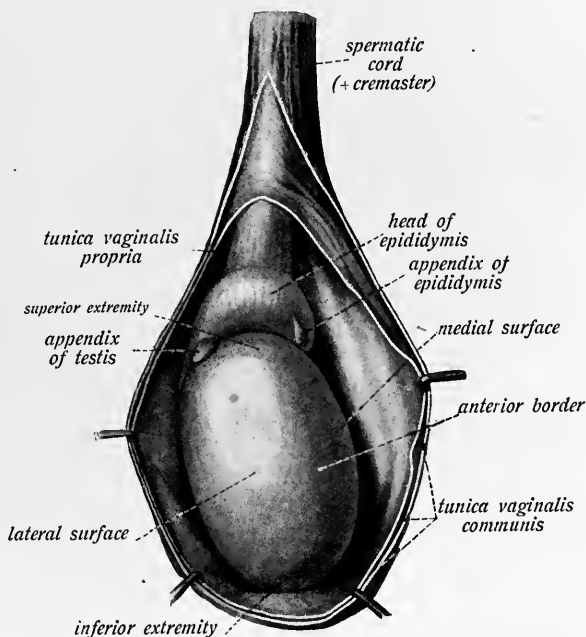


FIG. 177.—The testis and epididymis, with their investing membranes, seen from in front. (Sobotta.)

The posterior border of the testis bears a crescentic body, the epididymis. The upper extremity of the epididymis, or globus major, lies upon the upper pole of the testis and is enveloped by a serous covering except at its attachment to the testicle. The body of the epididymis is applied against, but is separated from the testis by an infolding of the serous covering of the organ, which forms an intervening pocket termed

the digital fossa. The lower and smaller extremity, or globus minor, is attached to the testis only by connective tissue and by the serous covering. From the globus minor the vas deferens proceeds upward in the loose tissue outside the serous sac.

The spermatic cord, which contains the bloodvessels of the testis, enters that organ at a point on the posterior superior border, mesial to the epididymis.

Arising from the groove between the globus major and the testicle is a fairly constant structure, the appendix testis, or hydatid of Morgagni. This has been found in 90 per cent. of testes examined and is a peduncu-

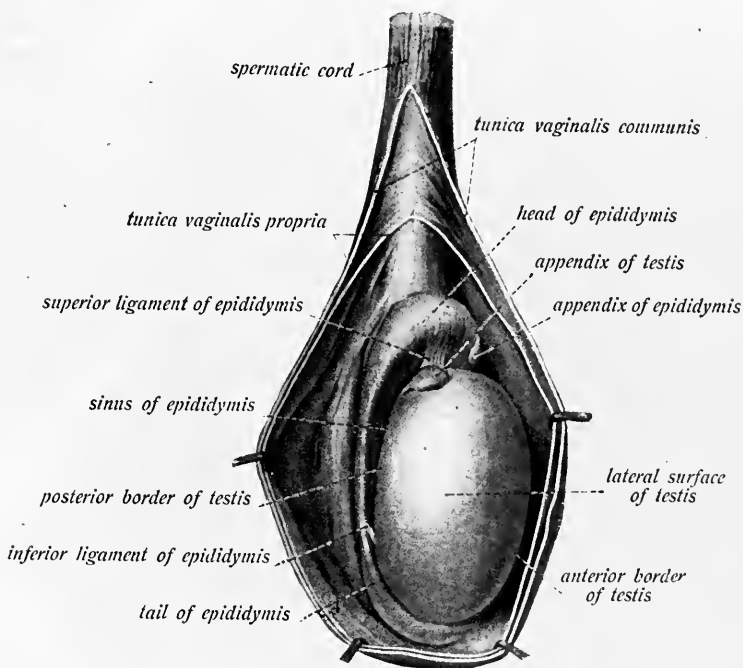


FIG. 178.—The testis and epididymis, with their investing membranes, seen from the lateral surface. (Sobotta.)

lated tumor consisting of vascular connective tissue and containing fragments of canals lined with simple columnar epithelium, sometimes ciliated.<sup>23</sup> It is thought to represent the Müllerian duct. Attached to the globus major of the epididymis is the paradidymis, or organ of Giraldès.

The *tunica vaginalis*, which lines the cavity in which the testis and epididymis are contained, consists of a parietal portion and a visceral portion. The parietal layer extends for some distance above the testis, and the space which it lines is considerably larger than the organs contained therein. The testis and epididymis are completely invested by the visceral portion, save at the points of contact between the two, at

the posterior border of the testis, where the spermatic cord is attached, and at the inner, posterior aspect of the epididymis.

The attachment of the testis to the scrotum at this point is frequently called the mesorchium. As Rigby and Howard<sup>40</sup> have pointed out, the mesorchium, properly speaking, lies between testis and epididymis, and is usually short; the attachment of testicle and epididymis to the scrotal wall should be called the *urogenital mesentery*.

**Finer Structure.—Testis.**—The testis is enveloped in a tough fibrous coat called the *tunica albuginea*. At the point of entrance of the spermatic vessels this becomes thicker and forms the *mediastinum*, or *corpus highmori*. The inner layer of the tunica albuginea is very vascular, and from it spring fibrous septa which, passing to the mediastinum, divide the testis into some 200 cone-shaped lobules. Each of

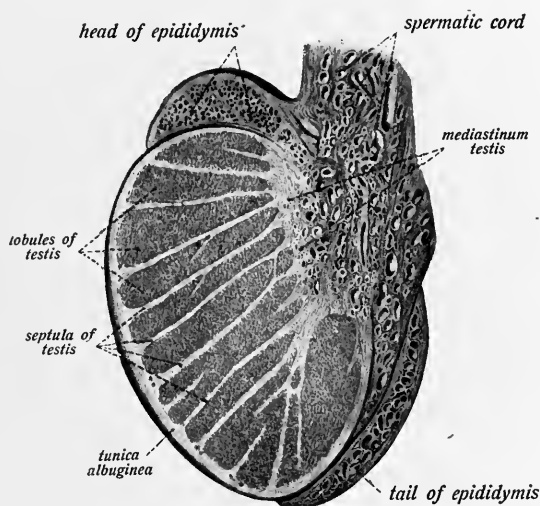


FIG. 179.—Longitudinal section of the testis and epididymis. (Sobotta.)

these contains three or four seminiferous tubules, which can be unravelled and appear to the naked eye like fine threads. They unite to form a smaller number of straight tubules, the *tubuli recti*, and these in turn open into the *rete testis*, a complicated network of canals occupying the mediastinum (Fig. 179).

**Epididymis.**—From the rete testis some fifteen or twenty ducts, so coiled as to present cone-shaped masses with their apices toward the testicle, carry the secretion to the main duct of the epididymis. The smaller ducts are the *vasa efferentia*, the single duct is the *ductus epididymidis*. About 20 feet long when unravelled, this duct comprises the body and lower pole of the epididymis, and leaves it as the *vas deferens* (Fig. 175).

**Histology of the Testicle.**—Aside from the connective-tissue framework, three kinds of cells occur in the testis. Two of these are found in

the seminiferous tubules—the *sustentacular* or supporting cells, often called the cells of *Sertoli*, and the *sexual cells* (Fig. 180). The latter may

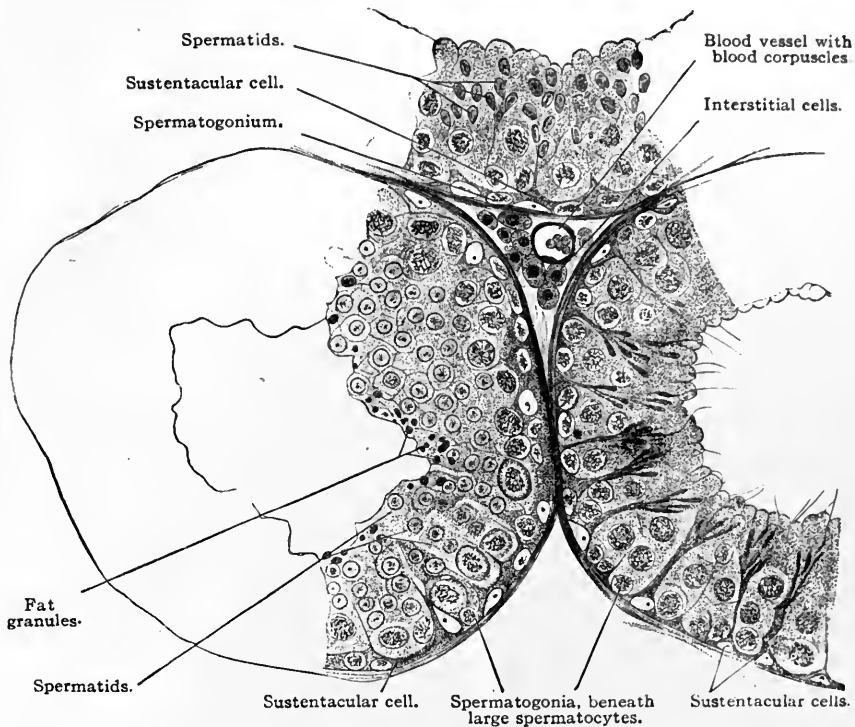


FIG. 180.—Cross-sections of seminiferous (convoluted) tubules of a mouse.  $\times 360$ . (Lewis and Stöhr.)

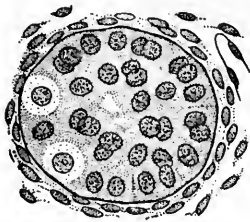


FIG. 181.—Cross-section of a convoluted tubule of the testis at birth. (Eberth.)

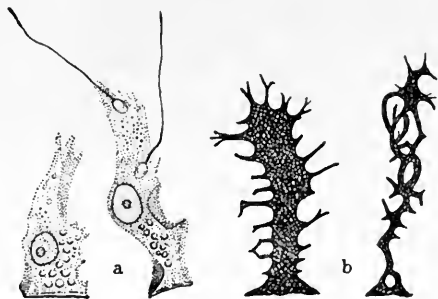


FIG. 182.—Sustentacular cells. *a*, isolated (Kölliker). *b*, Golgi preparations. (Böhm and von Davidoff.)

appear in any one of the five stages through which they must pass before becoming mature spermatozoa. (See *Physiology of the Testicle*, p. 427.) The sustentacular cells extend from the basal membrane of the tubules

toward the lumen. Early in life they form a syncytium; later, as spermatogenesis takes place, they become cylindrical in shape, with an outline made irregular by the pressure of the sexual cells which develop



FIG. 183.—From a longitudinal section through a convoluted tubule of a human testis.  $\times 360$ . (Lewis and Stöhr.)

between them (Figs. 181 and 182). Each cell has an ovoid nucleus with a distinct nucleolus; the protoplasm contains fat droplets, brown granules, and at times crystalloid bodies in pairs.<sup>21</sup>

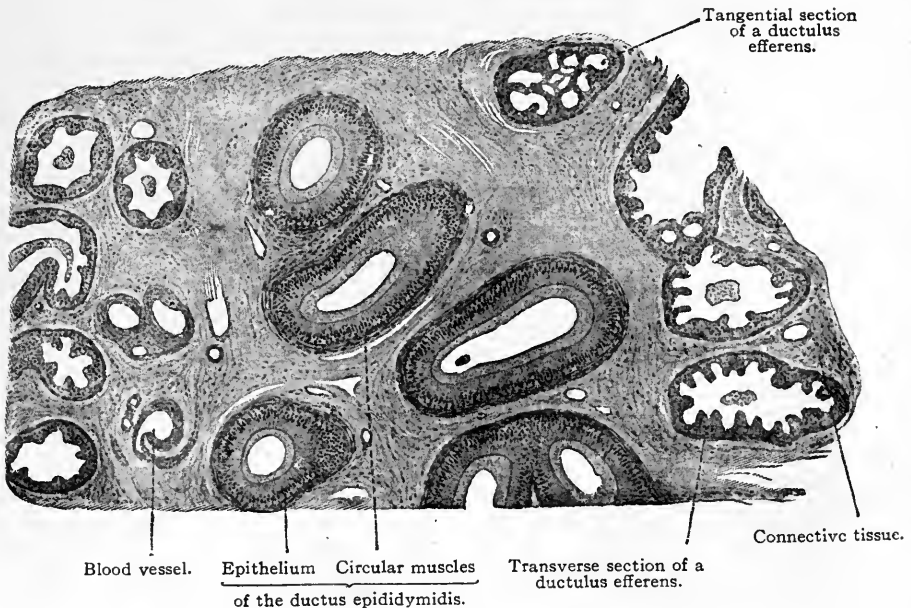


FIG. 184.—From a section of the head of a human epididymis, showing sections of the ductus epididymidis in the centre and of ductuli efferentes on the sides.  $\times 50$ . (Lewis and Stöhr.)

The third kind of cell, the *interstitial cell*, or cell of Leydig, occurs in the loose connective tissue between the tubules. These cells are

derived from the mesothelium of the genital ridge;<sup>51</sup> they are usually round or polygonal in shape, without distinct cell boundaries. Their protoplasm contains pigment and other granules, fat droplets, and rod-shaped crystalloids. During fetal life (Fig. 183) the interstitial cells are relatively abundant; after birth they rapidly diminish and are not much in evidence until puberty, when they undergo a renewal of growth and remain constant. After puberty they recede somewhat until senile changes set in, when they again increase.

**Histology of Epididymis.**—The epithelium of the convoluted tubules of the testis becomes more simple in the tubuli recti and rete testis, and in the *efferent ducts* of the epididymis consists of groups of columnar cells alternating with cuboidal cells. Often the tall cells, and occasionally the short ones, are ciliated. The efferent ducts have a circular coat of smooth muscle fibers containing elastic fibers. The *ductus*

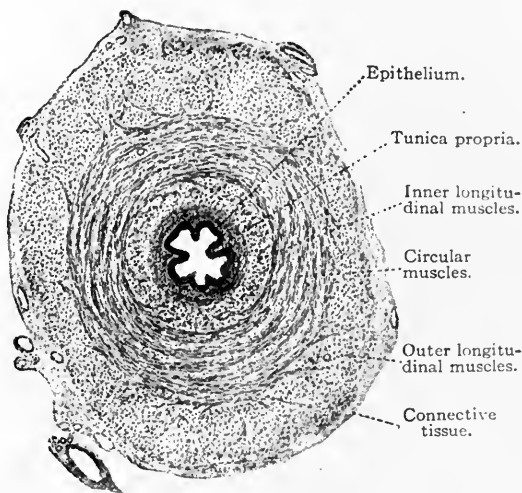


FIG. 185.—Cross-section of the human ductus deferens.  $\times 24$ . (Lewis and Stöhr.)

*epididymidis* is lined by a two-rowed epithelium with rounded basal cells and tall outer columnar cells. The latter have in the middle of their upper surfaces long non-motile hairs. A thick circular muscle layer surrounds the duct<sup>24</sup> (Fig. 184).

The *vas deferens* at the epididymal end is lined with two-rowed, ciliated epithelium, and is surrounded by three layers of smooth muscle, the inner and outer longitudinal, the middle layer circular (Fig. 185).

**Blood Supply of Testicle and Epididymis.**—The chief artery of the testis is the *internal spermatic*, which is given off the abdominal aorta just below the renal arteries, supplies a branch to the ureter as it crosses, and passes with the spermatic cord through the inguinal canal to the testicle. Before entering the testis it gives a branch to the globus major of the epididymis. The main stem then passes into the mediastinum, where it breaks up into many branches. These reach the

parenchyma through the tunica vasculosa and through the septules, and form capillary plexuses around the convoluted tubules. The body and tail of the epididymis are supplied by the deferential artery, which adheres closely to the vas deferens until it reaches the epididymis. This artery is a branch of the inferior vesical, or sometimes of the superior vesical.<sup>28</sup> A third artery enters the lower pole of the testis or epididymis. This is the *external spermatic, funicular* or *cremasteric* artery, which is given off the deep epigastric and runs in the fibrous sheath of the spermatic cord.

Picqué and Worms<sup>33</sup> have shown that in dogs there is free anastomosis between these three arteries. The exact nature of the anastomosis varies, but in every case of the 24 which they studied, the existence of such a communication was clearly shown. They found no connection between the arteries of the testicle and those of the scrotum.

The veins follow the arteries in the testicle and epididymis. Upon issuing from these organs, they form a plexus, the *pampiniform plexus*. The plexus is part of the spermatic cord, and consists of eight to ten veins; they traverse the inguinal canal, and near the internal ring terminate in two main trunks which higher up unite to form a terminal stem. The right terminal vein enters the inferior vena cava, the left one enters the left renal vein. The spermatic veins are provided with valves both in their course and at their terminations, but occasionally the valve at the orifice of the left spermatic vein is absent.<sup>7</sup>

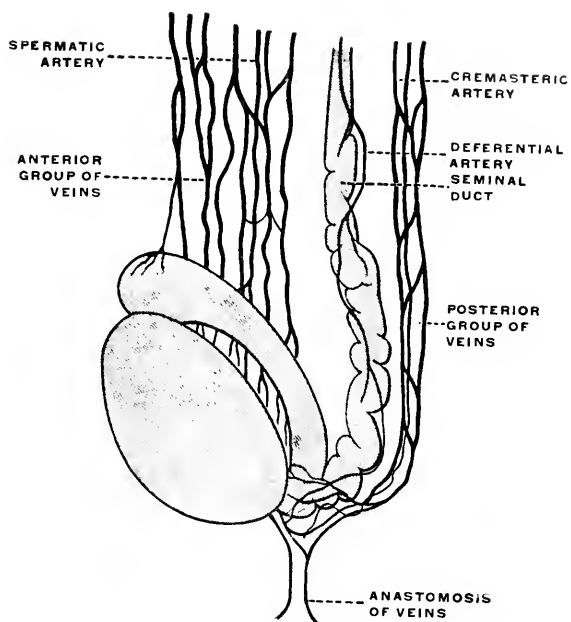
**Lymphatics.**—The lymphatics which drain the testes follow the spermatic cords and enter the lumbar nodes. These nodes, it will be remembered, also receive the drainage from the kidneys. The lymphatics of the vas deferens empty into the external iliac nodes.<sup>29</sup>

**Nerves.**—The nerves for the testis accompany the spermatic artery, and are derived from the aortic and renal plexuses. In the epididymis the nerves form the *plexus myospermaticus*, which is a network in the muscular coat of the ducts, provided with sympathetic ganglia.

### PHYSIOLOGY OF TESTICLE AND EPIDIDYMIS.

The testis appears to have two functions. One is concerned with the production and development of spermatozoa, the other has to do with the furnishing to the organism of an internal secretion. The first function is carried on by the cells lining the convoluted tubules, namely, the sustentacular cells and the sexual cells; the second, by the interstitial cells. The function of the sustentacular cells is to support and nourish the sexual cells during their development. Fig. 182 shows several spermatozoa with their heads embedded in the protoplasm of a sustentacular cell. It has already been mentioned that these cells abound in fat. Von Ebner<sup>49</sup> has described a circulation of this fat from the base of the sustentacular cell toward the lumen of the tubule, during the course of a spermatic generation. As the spermatozoa developed, the fat diminished. Hanes and Rosenbloom<sup>14</sup> have shown that the testes from cryptorchid pigs, in which there is very little sperma-

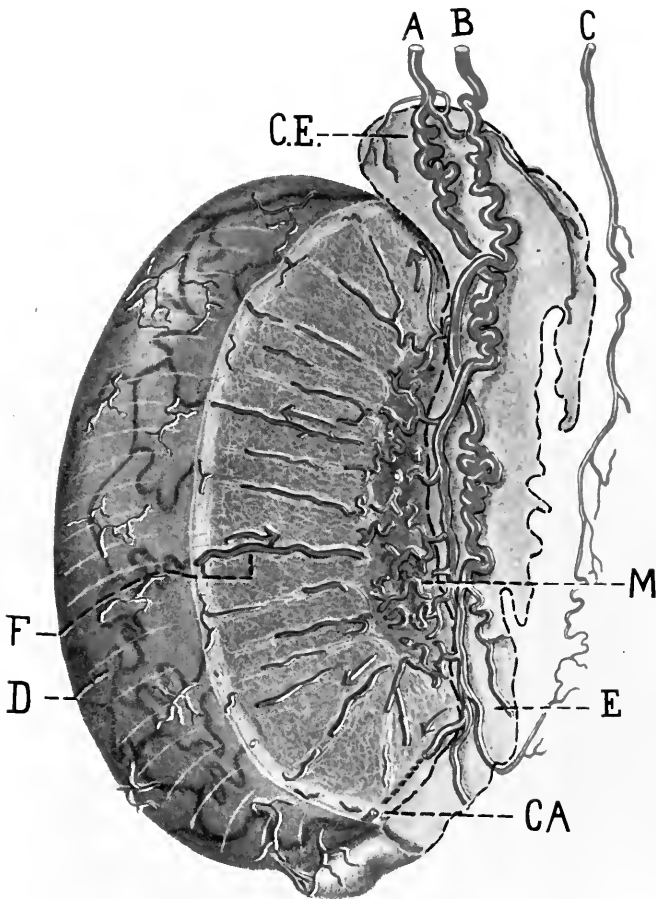
# PLATE III



The Arteries of the Testis and the Cord.



PLATE IV

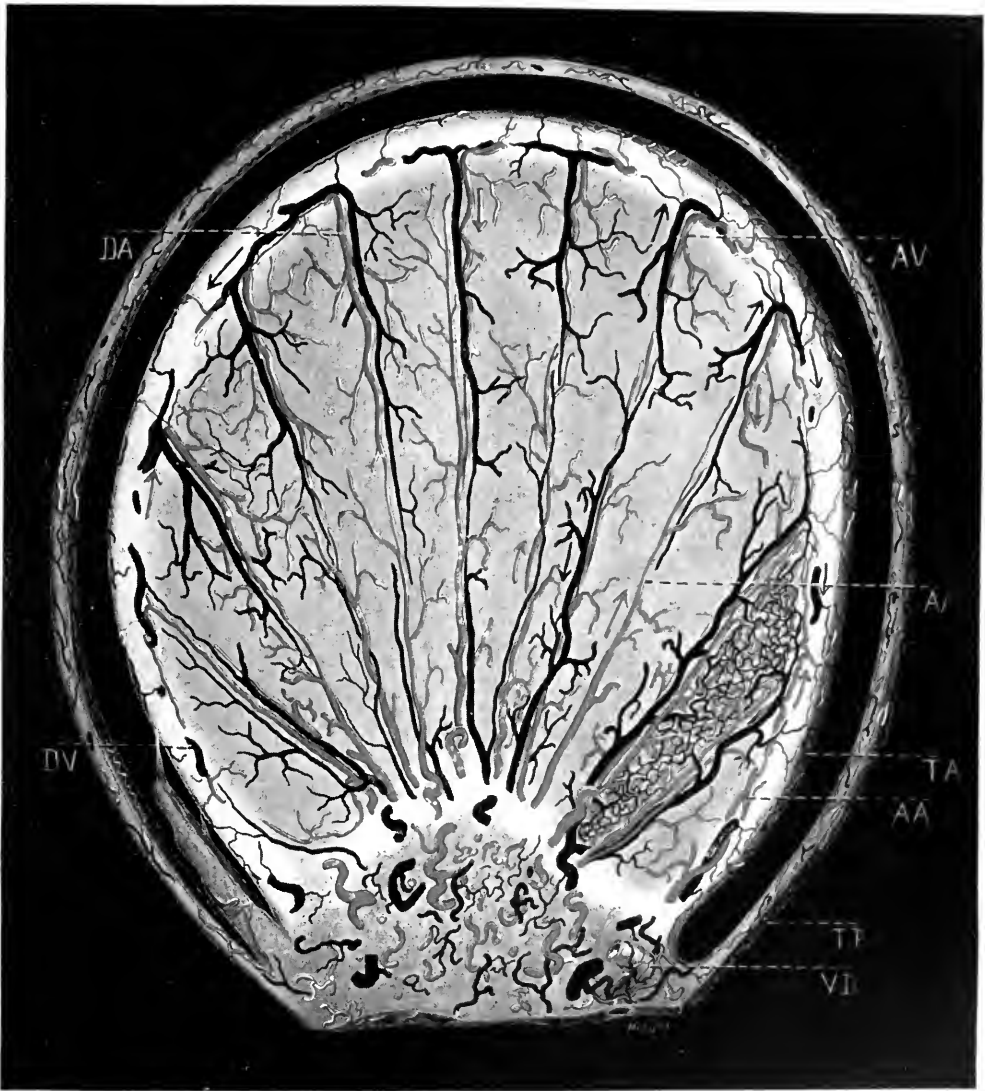


Arterial Supply of Human Adult Testis. A Portion of the Gland has been Removed so as to Show the Penetration of the Arteries through the Mediastinum into the Glandular Tissue.

*A, B*, main terminal branches to testicle; *C*, branch following spermatic cord and encircling and supplying vas deferens; *CA*, capsular artery—a branch from *B*; *C.E.*, caput epididymis—shown in outline; *D*, branch of capsular artery lying on innermost side of albuginea; *E*, outline of epididymis; *F*, central artery connecting vessels of mediastinum with capsular branches; *M*, mediastinum.  $\times 8\frac{1}{2}$ . (Hill.)



# PLATE V



Sagittal Section of Human Testis; to Show Blood Supply. Injected with Red and Blue Celloidin, cleared in 1 per cent. KOH and 20 per cent. Glycerin.  $\times 4$ .

AA, ascending artery; AV, ascending vein; DA, descending artery; DV, descending vein; M, mediastinum; VD, vas deferens; TA, tunica albuginea; TP, tunica parietalis. (Hill.)



togenesis, contain an excessive amount of fat, and they have also shown that as the fat passes toward the lumen of the tubule, it changes from a neutral fat to a lipid.

No further function of the sustentacular cells has been demonstrated.

The sexual cells undergo a transformation which is called "spermatogenesis." The cells pass through five phases: (1) The *spermatogonia*, or mother cells, lie nearest the basal membrane of the tubule. (2) Above them are the primary spermatocytes, which are larger; their nuclei usually show spiremes or other indications of cell division. (3) Secondary spermatocytes lie still nearer the lumen, and beyond them are (4) the spermatids. Each mother cell eventually divides into 4 spermatids. (5) Each spermatid develops into a spermatozoön. Van Beneden<sup>16</sup> has shown that in *ascaris* the number of chromosomes of the mother cell has been reduced, during these cell divisions, so that each spermatozoön contains only one-half as many chromosomes as did the mother cell. Von Bardeleben<sup>43</sup> extended this discovery to man, and it has been further shown that the mature spermatozoön contains one-half the number of chromosomes characteristic of the tissue cells of the species in question<sup>16</sup> (Fig. 183).

The change from spermatid to spermatozoön is shown in Fig. 186.

Mature spermatozoa are divided into three parts—head, neck and tail. When they become free they float in the albuminous fluid secreted in small amount by the tubules of the testis. They pass to the epididymis, in which they accumulate and in the secretion of which they first become motile. About 60,000 spermatozoa occur in a cubic millimeter of seminal fluid.<sup>24</sup>

In addition to its secretory function the epididymis, according to some observers, functions also as an organ of excretion. Belfield has demonstrated that particles of dyestuff after being injected into the anterior abdominal wall may be found in the tubules of the epididymis. He attributes this to the excretory function of the epididymis, due to its derivation from the Wolffian tubules, which were excretory organs.

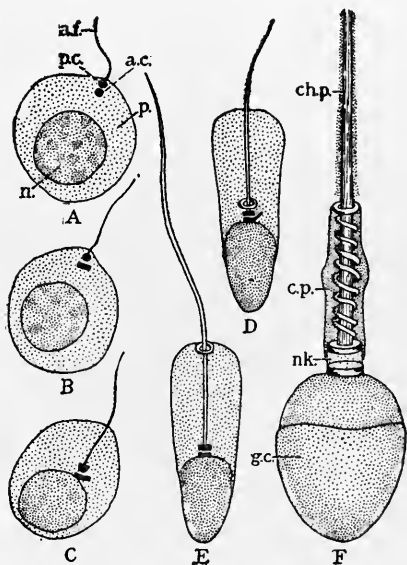


FIG. 186.—Diagrams of the development of spermatozoa. (After Meves.) a.c., anterior centrosome; a.f., axial filament; c.p., connecting piece; ch.p., chief piece; g.c., galea capitis; n., nucleus; nk., neck; p., protoplasm; p.c., posterior centrosome. (Lewis and Stöhr.)

**Interstitial Cells.**—It is a well-known fact that if the testes are removed from man or animal early in life the castrated individual will show failure of development of the so-called "secondary sexual characteristics."\* If the testes do not descend into the scrotum their spermatogenetic function in many cases atrophies. The tubules of the testis show fatty or fibrous degeneration, but the number of interstitial cells increases. In such cases the secondary sexual characteristics are well developed, and sexual desire may be above the average.<sup>13</sup>

This seems fairly conclusive evidence that the interstitial cells are responsible for an internal secretion which has considerable influence, to say the least, in the development of sex characteristics.

As Pappenheim and Schwartz<sup>35</sup> point out, lesions of other glands of internal secretion, such as the adrenals and pituitary body, are regularly accompanied by poor development of the sex characteristics, so that the testes alone are not responsible. Pappenheim and Schwartz maintain, furthermore, that the sustentacular cells cannot be excluded, inasmuch as they do not atrophy in many cryptorchids. Whitehead<sup>51</sup> presents a case which comes near to answering their argument. A stallion was not cured of his sexual desire by the removal of two apparently normal testicles. Two years later a third testis was removed from the abdominal cavity. His desire ceased. The testis on section showed marked increase of the interstitial cells, and atrophy of the sustentacular cells as well as of the sexual cells.

The interstitial cells contain granules which have the same staining reactions as do the granules in the cells of other organs of internal secretion. On the evidence so far presented it seems justifiable to state that the interstitial cells are at least intimately concerned in and necessary for the normal development of the secondary sexual characteristics. There is considerable evidence to show that their existence is essential to sexual desire.

### MALFORMATIONS OF THE TESTICLE.

A. Anomalies in development	Anomalies in number	In excess	Polyorchism	
		In deficiency	Absence	Anorchism
			Fusion	Synorchism
	Anomalies in size	In excess	Hypertrophy	
		In deficiency	Atrophy	
B. Anomalies in development	Testicle undescended	At some point in its normal course	Retention	
		Outside its normal course	Ectopia	
	Testicle descended	Upside down	Inversion	
		Hind side foremost	Retroversion	

(Adapted from Monod and Terrillon, p. 2.)

\* Such as deep voice, masculine form, hairy growth on body, etc., as well as sexual desire.

**Polyorchism.**—There seems good evidence that cases of more than 2 testes have occurred in man. D. S. Lamb<sup>19</sup> reviewed the literature on this point, and although he found the condition mentioned by Aristotle B.C. 350, and a good many times thereafter by other observers, he found only 23 cases in which the theory was supported by the presence of vas or epididymis in connection with the alleged extra testicle. It certainly is probable that in many cases the observer was misled by an encysted hydrocele or vestigial tumor, which happened to yield testicular sensation when squeezed. Lamb found reports of 6 cases, however, in which a third testicle was discovered at operation or at autopsy: 2 of them were in horses, 1 in a dog, 3 in men.

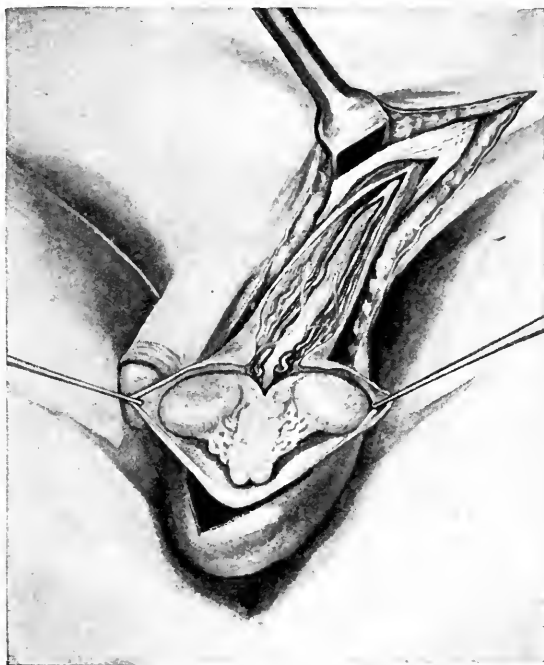


FIG. 187.—Ectopic testis, transverse section.

Lamb himself reported the case of a man examined during life by Lamb and numerous other observers, all of whom agreed upon the existence of a third testicle.

Arbuthnot Lane<sup>20</sup> removed a third testis from the right side of the scrotum of a boy, aged fifteen years. It was the size of a marble, but had no testicular sensation. It had a tunica vaginalis and vas deferens of its own. Microscopic sections were made. The other testis occupying the right side of the scrotum was extruded and seemed normal. The left was not exposed, but felt normal on palpation.

Whitehead<sup>51</sup> reports the examination of a third testis removed from

the abdomen of a horse which had had two testes removed in the usual manner two years before. It seems, therefore, that although extremely rare, triorchism may occur.

**Anorchism.**—Jacobson<sup>17</sup> credits to the French writers this classification of deficiencies in the seminal apparatus.

1. Absence of the testicle only.
2. Absence of the testicle, the epididymis, and a portion, more or less extensive, of the vas deferens.
3. Absence of the whole apparatus.
4. Absence of all or part of the excretory apparatus, the testicle being present.
5. Bilateral anorchism.

Jacobson, writing in 1893, had found recorded 5 cases of absence of the testicle only. The unilateral absence of testis, epididymis, and a portion of the vas was met most frequently; there were but 2 cases recorded of entire absence of the whole seminal apparatus. Absence of the epididymis alone may occur. Gruber, professor of anatomy in Petrograd, writing in 1868, could collect only 23 cases of unilateral and 7 of bilateral anorchism which were verified by autopsy.<sup>17</sup>

**Synorchism.**—The fusion of both testicles within the abdomen has been reported by Cruveilhier.<sup>6</sup> Their fusion within the scrotum has been reported by Lenhossék<sup>21</sup> and by A. E. Halstead,<sup>12</sup> in whose case the epididymes were fused (Fig. 187).

**Hypertrophy and Atrophy.**—The condition of atrophy of one testicle is not infrequent, and many times no history of a preceding lesion can be found to account for the condition. In some of these cases, the other testicle appears to have undergone hypertrophy.

### IMPERFECT DESCENT OF THE TESTICLE.

The descent of the testicle may be stopped at any point. Retention within the abdomen is the least common variety, and, as the testis is hidden from view, the condition is called "cryptorchism." The term is loosely applied to other forms of arrested descent as well. Within the abdomen, the organ may remain in the iliac fossa close to the spine, or may stop just inside the internal inguinal ring. The most usual form of incomplete descent is the "inguinal," in which the testis is retained within the canal. Or the descent may stop just after the testis has emerged from the canal. (Cruroscrotal or scrotofemoral retention.) The testicle may be movable and change its positions frequently, so that at times it belongs in one group, at times in another.

The cause of arrest of descent of the testicle is not clearly worked out. Certain it is that in operations for this deformity, shortness of the spermatic vessels offers the greatest obstacle to placing the testis in the bottom of the scrotum. Eccles<sup>10</sup> mentions a number of conditions which may be factors in producing the anomaly. These are:

Conditions associated with the mesorchium:

1. The mesorchium may be too long. The testis would then hang

too freely within the abdominal cavity, and thus be prevented from engaging in the opening into the inguinal canal.

2. Adhesions may have formed between the peritoneum of the mesorchium and the adjacent portion of the peritoneum.

3. An abnormal persistence of the plica vascularis may unduly tether the testis.

Conditions associated with the testis and its component parts:

1. The spermatic vessels may be too short.

2. The vas deferens may be of insufficient length.

3. The testis itself may be of abnormal size as compared with the usual size of the track along which it has to leave the abdomen.

4. The epididymis may be of abnormal size.

5. There may be a fusion of the two testes.

6. Certain forms of hermaphroditism.

Conditions associated with the gubernaculum testis:

1. There may be a deficiency or absence of the lower or scrotal attachments.

2. There may be a deficiency of the activity of its muscular fibers.

3. Possibly even a want of its upper attachments may lead to a fault in descent.

Conditions associated with the cremaster:

1. A want of action of the internal fibers of the cremaster before the testis has reached the inguinal canal.

2. A retraction by the action of the cremaster of the testis after it has gained its normal position in the scrotum.

Conditions associated with the route along which the testis passes:

1. An ill-development of the inguinal canal.

2. An ill-development of the superficial abdominal ring.

3. An ill-development of one-half of the scrotum.

Other conditions not falling under the above headings:

1. Pressure of a truss for an accompanying hernia preventing the onward passage of the testis from the inguinal canal to the scrotum.

In certain cases, although the body of the testis proper may be retained within the canal, the vas and even the epididymis may descend to a much lower level, and can be felt outside the canal.<sup>10</sup>

**Incidence.**—Incomplete descent of the testicle during the first few months of life is quite common. Soch in the examination of 143 male infants of from one to four months of age, found this condition in 14 per cent. In 60 per cent. of these it was bilateral. The great majority of such testicles descend during the first year, and a few of the remaining descend during the years before puberty. Odiorne and Simmons<sup>31</sup> reported 3 cases in which descent occurred at fourteen years of age.

In adults incomplete descent of the testicle is by no means rare. Marshall<sup>25</sup> found 12 cases in 10,800 recruits (0.1 per cent.). Hempel<sup>15</sup> gathered statistics which showed that in 7,000,000 Austrian recruits, 14,000 were so affected (0.2 per cent.).

Neither side appears to be particularly liable to this anomaly

(Jacobson). Of the 77 cases reported by Odiorne and Simmons, 15 were bilateral, 39 were on the right side, 23 on the left.

*Ectopic Testis.*—When the testicle, instead of reposing at some point along the usual path of its descent, lies outside that path, the condition is known as *ectopia*. The testicle may become ectopic through violence (see Injuries of Testicle); the condition is then known as *luxation of the testicle*. Congenital ectopia is believed to be due to an abnormal pull exerted by certain fibers of the gubernaculum, associated perhaps with some abnormality of the testis or inguinal canal which hinders proper descent. Constant pressure by an accompanying hernia, especially if further progress is impeded by some abnormality ahead of the testicle, may also be a factor in driving it out of its course (Eccles).

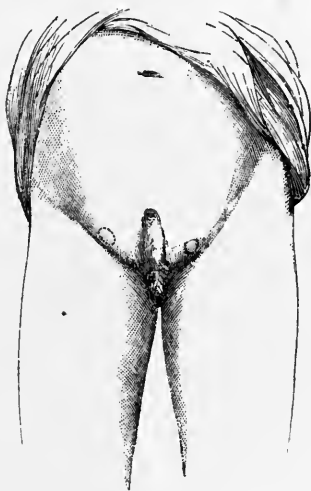


FIG. 188.—Inguinal retention, on both sides, in a boy aged twelve years; interstitial subvariety. The dotted lines indicate the position of the testes. The left is a little lower than the right. The scrotum is ill-developed. (Osborn.)

The varieties of ectopia are:

1. Interstitial. The testicle lies properitoneally (Hempel) or in front of the aponeurosis of the external oblique.

2. Penile. The testis lies in the soft tissues between the root of the penis and the pubes. Two cases have been reported by W. Popow,<sup>33</sup> and one by J. Poupart.<sup>37</sup>

3. Crural (or Femoral). The testis lies in Scarpa's triangle. Jacobson<sup>17</sup> quotes several cases in which the testis left the abdomen by the crural canal. Eccles<sup>10</sup> casts doubt upon the accuracy of the observations in such cases, and says that in careful dissections the cord has always been found to lie in front of Poupart's ligament.

4. Perineal. The testis lies in the perineum; the scrotum on the side of the ectopia is usually atrophied. A firm band of tissue holding the testicle to the spine of the ischium can generally be felt. This is the

type of ectopia most frequently encountered, and seems to result in less damage to the testicles than do the other kinds<sup>15</sup> (Fig. 188).

5. Transverse. Both testes descend by the same inguinal canal. Cases have been reported by Lenhossék,<sup>21</sup> in 1845, Jordan,<sup>18</sup> in 1885, Berg,<sup>2</sup> in 1904, and A. E. Halstead,<sup>12</sup> in 1907.

Inversion and retroversion of the testis need only be mentioned. The latter condition, in which the epididymis is toward the front, is said by Rigby and Howard<sup>39</sup> to occur once in every twenty men, a statement which we cannot believe represents the facts.

**The Effects of Incomplete Descent upon the Testis Itself.**—The effects of incomplete descent upon the testis are much the same whether the organ is arrested in its normal path or whether it is ectopic. The exposure of the testicle to the pressure of overlying tissues and to repeated knocks

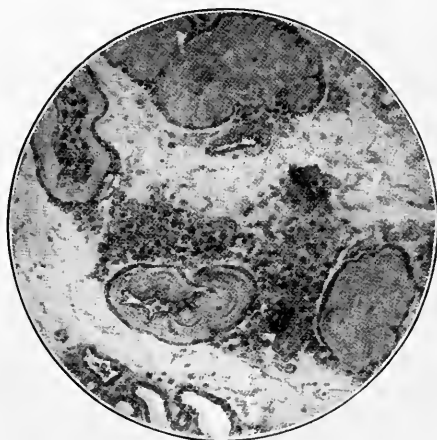


FIG. 189.—Section from undescended testicle removed from man of twenty-nine years. Position pubic. The testicle was soft, 2 x 1 cm. in diameter, and fastened to the wall of the hernial sac. The greater part of the organ was composed of rather dense fibrous tissue with many small oval nuclei and containing large numbers of Reinke's crystals. There were many interstitial cells. The tubules were scattered irregularly throughout the sections and for the most part were represented by masses of hyaline tissue. This case illustrates the more advanced type of atrophy. (Odiorne and Simmons.)

such as a normally descended gland would escape are the only factors which are known to have a harmful influence.<sup>1</sup> The atrophy is probably due to anemia caused by constant pressure upon the circulation in the testis and results in small, soft testicles with disturbed function.

The fact remains that practically all undescended testicles show definite changes in function and in morphology. The spermatogenetic function weakens or disappears entirely; undescended testicles are usually, though not always, sterile. The sexual cells disappear, although their supporting cells, the sustentacular cells, show no alteration except an increase in the amount of fat which they contain. Men with bilateral undescended testes, on the other hand, are not impotent; the interstitial cells show hyperplasia, and this overdevelopment is more marked in

undescended testes the fellows of which are wanting. In some testicles the degenerative changes advance so far that even the interstitial tissue is affected, the entire testis becoming merely a fibroma<sup>34</sup> (Figs. 189 to 191).



FIG. 190.—Section from an inguinal testicle from a man of twenty-three years. The testicle was 3 x 1.5 cm. in diameter. There was no increase in the fibrous tissue, which, however, contained many small areas of interstitial cells. The basement membrane of the tubules was only slightly thickened, but they contained only sustentacular cells, no spermatogenic cells being seen in any section. (Odiorne and Simmons.)



FIG. 191.—Section from an inguinal testicle from a man of thirty years. The fibrous tissue was increased and contained many interstitial cells. The tubule in the lower part of the field is nearly obliterated by the thickening of the basement membrane. The tubule in the upper part of the field shows active spermatogenesis in the lower portion. (Odiorne and Simmons.)

The age at which these changes occur is variable; authorities differ on this point. The subject is of considerable importance, inasmuch as the best time to operate depends upon the age at which degenerative changes commence. G. Bellingham Smith<sup>43</sup> examined six undescended

testes from boys under the age of puberty and found all of them smaller than normal, with fewer tubules and more interstitial cells. This condition held even in a testis from a three-year-old boy. On the other hand, a number of instances have been reported of young men with both testicles undescended who have been fertile.<sup>1</sup> Odiorne and Simmons published microphotographs from an undescended testicle in a man, aged thirty years, in some of the tubules of which active spermatogenesis was going on (Fig. 191). Beigel<sup>1</sup> found living spermatozoa in the semen of a man, aged twenty-two years, with bilateral inguinal retention. Monod and Terrillon<sup>27</sup> and Jacobson<sup>17</sup> believe that in young adults undescended testes may still be fertile, but that with the atrophy which is certain to follow, sterility is sure to result.

In addition to the above-mentioned changes the undescended testicle is likely to be tender, and is particularly liable to injury. If retained in the inguinal canal the pressure of the fascia as the abdominal muscles contract may be the cause of pain. Ectopic testicles of the perineal type are particularly exposed in riding horseback. Those of the penile type suffer during intercourse. Undescended testicles are liable to any of the diseases which affect the normal organ, perhaps to an even greater degree, and the process, if inflammatory, may set up a peritonitis through the open processus vaginalis. Hydrocele may exist. Eccles relates a case in which the fluid collected in the scrotal part of the tunica vaginalis, while the testis remained in the inguinal canal.

*Torsion* is especially prevalent in undescended testes. In the 32 cases of torsion collected by Scudder<sup>42</sup> in 1901, 47 per cent. were in undescended testes. Eccles (p. 64) gives the following predisposing causes for torsion of the retained testicle:

1. Imperfect descent of the testis.
2. Abnormally long mesorchium.
3. Practical absence of a mesorchium.
4. Action of the gubernaculum testis.
5. A congenital twist of the cord.
6. A roomy tunica vaginalis.
7. A flattened condition of an imperfectly descended testis.

He believes that the chief predisposing cause at work is partial descent with a freely movable testis.

The exciting causes of torsion he considers to be:

1. Muscular effort.
2. A mechanical twist.
3. The action of the cremaster.
4. The application of a truss.
5. Attempts at a reduction of the hernia by taxis.
6. Approach of puberty.

The symptomatology, pathology and treatment of torsion will be taken up under *Torsion of the Testicle*.

Coincident with failure in the descent of the testicle, there frequently exists failure of the processus vaginalis to close. A path is

thereby left open for the protrusion of the abdominal viscera. Every undescended testis, says Moschkowitz, is accompanied by a potential or an actual hernia. In the 92 undescended testes reported by Odiorne and Simmons, hernia was present in 49 (57 per cent.). Of these, 10 were strangulated. In some cases the hernia occupies a separate sac, or the hernial sac may invaginate the tunica vaginalis as it blocks the inguinal canal. A hernia of such a type is doubtless brought about by the dilatation of the inguinal canal caused by the retained testicle. The testicle may act as a ball valve and bring about strangulation of the hernia or may block its progress through the canal and force it to burrow out between the muscular layers.

**Diagnosis.**—The differential diagnosis between strangulation of a hernia accompanying an undescended testis and acute epididymitis or torsion of the testicle itself may be difficult, particularly in the first twenty-four hours. A strangulated hernia is less painful locally but more disturbing generally; the vomiting is more persistent, the temperature normal or subnormal; the abdomen increasingly distended. Torsion of an undescended testicle is most painful at first, the pain decreasing after a few hours. There may be nausea, but the vomiting is not so marked a feature. The temperature is normal or slightly elevated. Locally, the tenderness is intense, the swelling only moderate in degree. The overlying skin may be reddened. Clear urine and a negative history of urethritis favor both these diseases, whereas the presence of a urethral infection would make one strongly suspicious of acute epididymitis. If epididymitis is developing, the temperature is likely to be elevated; the testicle is not much enlarged, but is acutely tender. The overlying skin reflects the underlying inflammation by edema and redness. After the first twenty-four hours, the epididymis may be differentiated from the testicle.

Whichever diagnosis is arrived at, there is but one safe course. Operation at once is indicated, not only to relieve the possible strangulated hernia, but to prevent the infection which may develop in torsion or in epididymitis from spreading to the peritoneal cavity through the hernial sac which is almost always present.

**Treatment of Undescended Testicle.**—To recapitulate briefly, the undescended testicle if left alone is almost sure to cease functioning; it is liable to injury, to torsion, perhaps to tumor growth. The chances are more than even that sooner or later a hernia will develop. In very young children the descent of the testis may be encouraged by gentle massage above and behind the gland (Langenbeck). The use of a forked truss is not advised by Moschkowitz. If the testis does not descend of its own accord, operation is indicated.

**Age at Operation.**—Most writers on this subject are agreed that operation before the age of three is contra-indicated by smallness of the parts and the difficulty in keeping the child dry. As to the time of election for operation, there is a diversity of opinion. Moschkowitz does not operate on children under three years. Bevan thinks from six to twelve years is the best time; Eccles, from six to eight years.

*Operative Treatment.*—In the history of operative treatment of undescended testicle three operations appear—orchidectomy, reposition of the organ within the abdomen, and orchidopexy, or the placing of the testicle within the scrotum. Today the only indications for orchidectomy are the presence of neoplasm or of such injury to the testicle through gangrene, inflammation or fibrous change as to render it worthless or dangerous to the individual. Reposition of the testes within the abdomen is bad surgery. Their function will be destroyed, and if any of the accidents to which the testicle is liable should befall them, they are inaccessible. The only justifiable operation for an otherwise healthy retained testicle is orchidopexy, and every undescended testicle which can be palpated should, according to Bevan,<sup>4</sup> be so treated. Even intra-abdominal testes, provided they give symptoms, should be brought into the scrotum. The first operation for this purpose was described by Schüller<sup>41</sup> in 1881. He advised closing off the processus vaginalis to make a tunica vaginalis, repair of the accompanying hernia and suture of the testis to the bottom of the scrotum. Various modifications of this operation were suggested, the innovation usually consisting of a new method of anchoring the testicle in the scrotum.<sup>30</sup> None of these was generally successful, however. The testicle would retract. It remained for A. D. Bevan,<sup>3</sup> in 1899, to suggest an operation which would give the three essentials—namely, a viable testis, the permanent establishment of that testis well down in the scrotum, and the repair of the accompanying hernia.

Bevan pointed out that the structure which prevented the placing of the testicle in the scrotum was not the vas deferens, but was the spermatic cord. He therefore lengthened this cord as much as possible by separating the adhesions between its loops and by freeing it from the peritoneum of the lateral and posterior walls of the abdominal cavity. If it was still too short he cut it, leaving the testicle to draw its blood supply from the deferential artery. As has been shown by Picqué and Worms and by other observers, there is a constant anastomosis between the spermatic, the deferential, and the funicular arteries, so that division of any one of these three is compatible with the life of the testicle. Moschkowitz ligated the spermatic vessels in dogs and examined the testes from four days to three weeks after ligation. The testes removed a few days after ligation showed some necrosis of the interior, but a fair state of preservation around the periphery. The ones removed later showed no important lesion. Bevan's operation has now been done many times with good results (Moschkowitz, Ochsner,<sup>33</sup> Bevan) in marked contrast to the results obtained by the earlier operations (Odiorne and Simmons, Broche<sup>3</sup>).

A recent paper by C. G. Mixer,<sup>26</sup> reporting end-results in cases of undescended testicle operated at the Children's Hospital, Boston, puts this operation in rather a different light. Of 9 cases in which the spermatic cord had been severed, 7 reported, and in every case the testicle showed marked atrophy. In 14 cases in which no spermatic vessels were cut, no testicles were atrophied. Three cases in which the

spermatic vessels were cut had undescended testicles on the other side; Mixer says "in every case the testicle was atrophied on the side where the vessels were cut, while where the vessels were left intact the testicle developed normally."

It is our feeling, therefore, that the ligation and division of the spermatic cord should be avoided, as it is almost certain to result in atrophy of the testicle. The other points to which Bevan calls attention, particularly the stripping of the peritoneum off the cord, are important.

The steps of the operation are as follows<sup>4</sup> (Figs. 192 to 204).

If the gland is palpable, make an incision three inches long over the inguinal canal. Do not carry the incision below the external inguinal ring. Open the canal. Divide the cremasteric and transversalis fasciæ. Open the processus vaginalis. Divide the sac at its neck, and

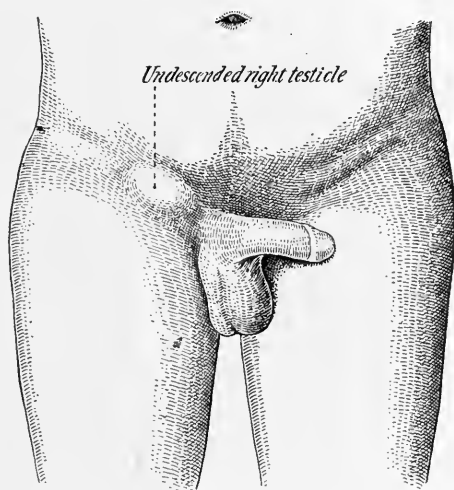


FIG. 192.—Undescended testicle. (Bevan.)

free the peritoneal portion from the spermatic cord. Close the lower portion of the processus vaginalis\* around the spermatic cord by means of a purse-string suture, to form a tunica vaginalis. Draw down on the cord, meanwhile dividing with tissue forceps the little bands of fascia which bind the loops of the vessels together. With one finger in the abdominal cavity, free the spermatic vessels from the posterior surface of the peritoneum. Distend the scrotum with the fingers, and place the testicle therein. If the spermatic cord is still too short it may be divided between ligatures. If this is done the vas and its artery must be handled with particular care, since the blood supply of the testis depends upon their integrity. After the testis is placed in the scrotum a purse-string suture is taken through the neck of the scrotum in front of

\* Closure of the processus vaginalis around the spermatic cord, as advised by Bevan, is almost certain to produce a hydrocele.—Editor.

the vessels. The suture should pass through the superficial fascia and the pillars of the external inguinal ring as well.

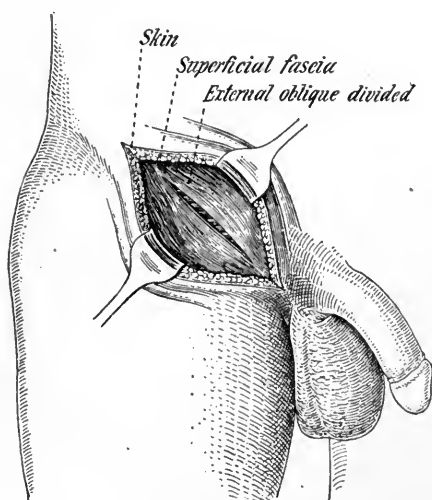


FIG. 193

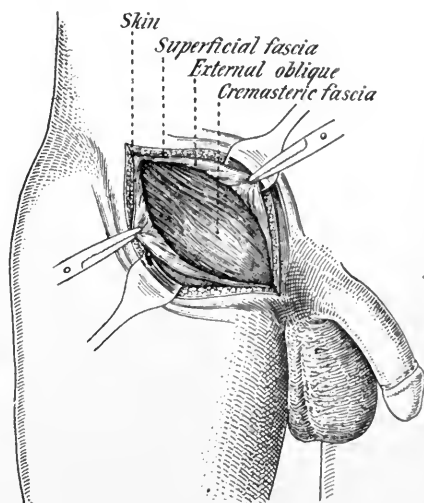


FIG. 194

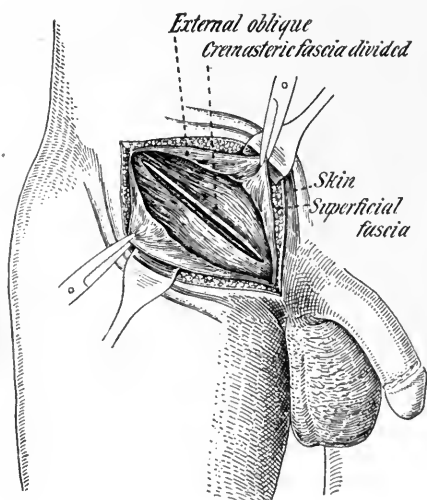


FIG. 195

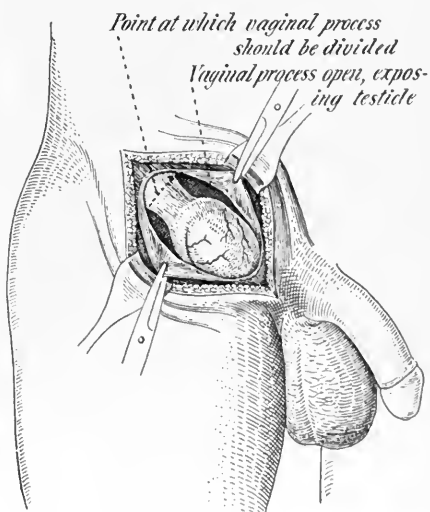


FIG. 196

FIGS. 193 to 196.—Undescended testicle. (Bevan.)

The neck of the hernial sac is then closed and the conjoined tendon sutured to Poupart's Ligament *in front of* the cord. The aponeurosis of the external oblique and the skin are closed in the usual way.

A few minor changes from this operation have been suggested. Moschkowitz removes the parietal portion of the processus vaginalis

instead of using it to make a tunica. Davison<sup>9</sup> divides the deep epigastric artery and the floor of the inguinal canal, thereby bringing the

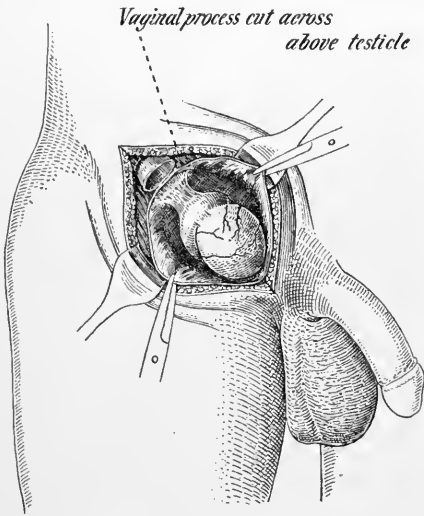


FIG. 197

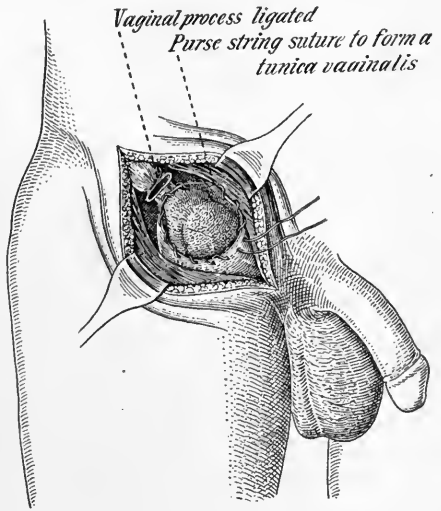


FIG. 198

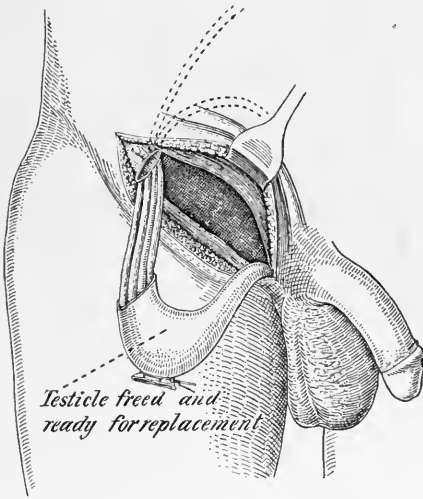


FIG. 199

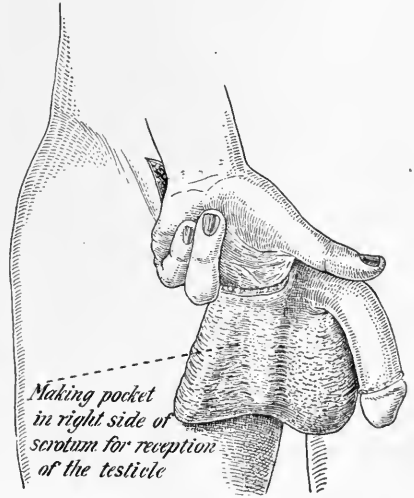


FIG. 200

FIGS. 197 to 200.—Undescended testicle. (Bevan.)

spermatic vessels to the external inguinal ring in a more direct line than if they had to pass through the internal inguinal ring.

Wolfer<sup>52</sup> divides the transversalis fascia as far as the pubes, lifts up the epigastric artery and vein, brings the testis down behind the latter, and by stripping the spermatic cord off the bulge of the peritoneum, he

materially shortens its course. Mosehkowitz mentioned a procedure similar to this in 1910, and declared it to be an "unnecessary and bothersome refinement."

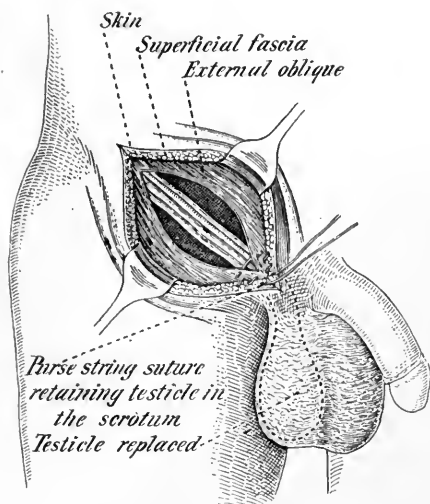


FIG. 201

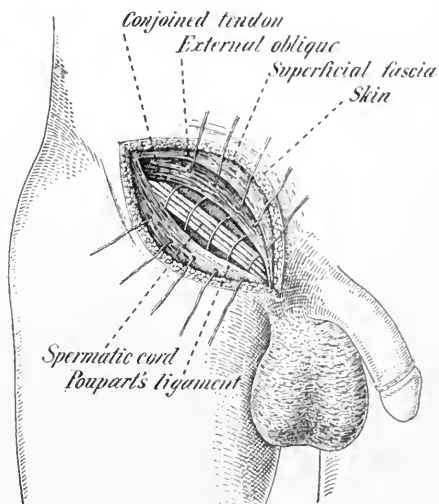


FIG. 202

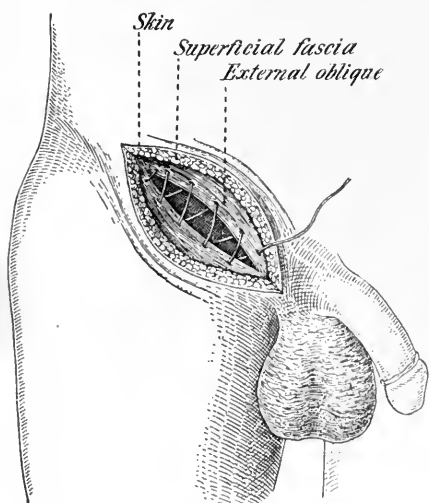


FIG. 203

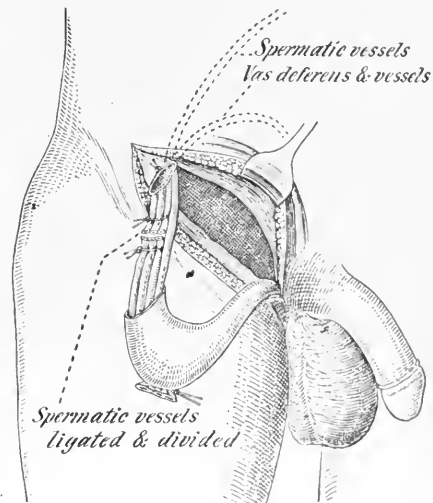


FIG. 204

FIGS. 201 to 204.—Undescended testicle. (Bevan.)

Orchidopexy in the case of ectopic testes is usually made easy by the fact that the spermatic cord is already of sufficient length. It is desirable to obliterate the old bed of the testicle; otherwise recurrence may take place.

## INJURIES OF THE TESTICLE.

**Luxation or Dislocation of the Testicle.**—Luxation or dislocation of the testicle is usually the result of an accident, such as the passage of a wagon wheel across the pelvis. The testicle may be driven over the pubes or toward the anterosuperior spine of the ilium. Guiteras<sup>11</sup> records a case in which the testicle was torn loose from the body and tail of the epididymis and was driven out of the scrotum and under the skin on the side of the penis. A review of the literature by Nicolas,<sup>32</sup> in 1899, disclosed 3 cases in which the testis had been driven onto the side of the penis, 3 in which it had been driven over the pubis and 2 in which it was forced into the groin. Nicolas says that unless the testis is replaced, it undergoes atrophy. Summerhayes<sup>44</sup> reported a case in which the testicle was extruded through a rent in the scrotum by a blow from a log of wood.

**Hematocoele.**—Hematocoele is a frequent accompaniment of injuries of the testicle. The tunica fills with blood, which clots and forms a tender, solid-feeling tumor, which does not transmit light. Later on, this will liquefy and become a dark brown, oily-looking fluid, or will be entirely absorbed. From an injury of less severity, traumatic *hydrocoele* may result. Hydroceles of this origin are only temporary. Severe injuries of the testicle itself are not met with very frequently. The fact that the testes lie in a movable bed, between the fleshy parts of the thighs, saves them from many a crushing blow. The most frequent type of injury is that sustained by falling astride some hard object, such as a fence. In such cases the testicles are caught between the hard object and the bony pelvis.

Terrillon and Suchard,<sup>45</sup> in experimental work on dogs, showed that punctured wounds and foreign bodies in the testicle caused only local disturbance. Slight blows upon the fixed testicle caused only a feeble reaction. More severe blows caused reaction in both testis and epididymis, more marked in the latter. The epididymal canals were dilated, the cilia of the epithelium was lost, and the epithelium was thickened in places by the accumulation of new cells. Injuries of still greater degree caused the formation of fibrin in the tunica, and in the testis the degeneration of peripheral tubules and an inflammatory reaction in the interstitial tissue. Terrillon and Suchard thought this inflammation would result later in the formation of scar tissue and the consequent atrophy of the testis. Injuries of the most severe type caused rupture of the tunica albuginea. The testicle contained ecchymotic areas and was of a yellowish-red color; the epididymis was swollen and ecchymotic, and examination of microscopic preparations showed proliferation in the interstitial tissues as well as in the canals.

Terrillon and Suchard conclude that changes are more marked in the epididymis than in the testis. In the former, the epithelium is chiefly involved; in the latter, the interstitial tissue. The subsidence of the interstitial reaction is likely to cause scar formation with resulting atrophy of the testicle.

The treatment consists of rest, elevation of the scrotum and the application of ice.

### TORSION OF THE TESTICLE.

**Incidence.**—Torsion is probably more frequent than would appear from the cases reported. Without doubt a number of cases are thought to be orchitis or epididymitis, and if they quiet down, the diagnosis is never made. From 1840, when the first case was reported, to 1901 Scudder<sup>42</sup> collected 31 instances from the literature and added 1. In 1907 Rigby and Howard<sup>39</sup> collected 40 cases.

**Age.**—Torsion may occur at any age. It has been reported in a newborn child and in a man aged sixty-two years. It is chiefly a disease of adolescence. Of Scudder's series of 32 cases, 75 per cent. were under twenty-four years of age; 20 of the 32 were between the ages of thirteen and twenty-three years.

**Cause.**—That torsion is due primarily to some anatomical abnormality is indicated by the fact that of Scudder's 32 cases of torsion, 47 per cent. were of undescended testicles. A number of those who have reported cases have mentioned finding some anomaly, such as an unusually long mesorchium.

The predisposing factors which have been found associated with torsion of the undescended testis are given on page 435. In connection with fully descended testicles, Rigby and Howard mention the following anomalies:

1. Abnormal attachment of the common mesentery and vessels to the lower pole of the testis and to the globus minor, so that the testis is attached by a narrow stalk instead of by a broad band.

2. Elongation of the globus minor.

3. Capacious tunica vaginalis.

The exciting cause may be exercise or violent straining, but 2 cases are reported by Rigby and Howard in which torsion occurred during sleep. In a case recently operated at the Massachusetts General Hospital the torsion came on during sleep. A case of recurrent torsion has been recorded<sup>47</sup> in which the patient learned to untwist the torsion himself.

**Pathology.**—Upon opening the tunica, more or less bloody fluid is evacuated; the testis and epididymis appear swollen, indurated and almost black in color. The spermatic cord is thrombosed below the twist, normal above. The twist may consist of from one-half a turn to four half-turns, in either direction. The cut surface of the testicle resembles blood clot. Hemorrhagic infarction may occur, or hemorrhage between the lobules (Scudder). In one of Rigby and Howard's cases, microscopic examination showed no normal testicular cells. Later stages of the lesion will show atrophy, more or less complete, or sloughing. The latter is more liable to occur if hernia coexists, Rigby and Howard believe, as the bacteria of the intestine are thus brought nearer to the devitalized testis.

**Symptoms.**—Severe, sudden pain in the testicle, sufficient to cause slight shock with nausea and vomiting, occurs at the time of the twist. Not infrequently this occurs at night. The temperature may rise slightly. The skin over the affected testicle becomes edematous and red. Differentiation between the testicle and epididymis on palpation



FIG. 205.—Gangrene of the testicle due to torsion of the cord. The testicle and epididymis were gangrenous from a point just above the epididymis. Testicle and epididymis considerably enlarged from edema. There were areas of hemorrhage and beginning necrosis on the surface and in the interior of the organs. There was associated hydrocele of the cord (A) dependent upon the strangulation of the cord. (Scudder.)

is lost. At first the tumor is exquisitely sensitive; after a few days the acute tenderness subsides, but tenderness on pressure may persist for weeks.

**Diagnosis.**—In the case of torsion of the undescended testis the condition most difficult to differentiate is strangulated hernia. (See page 436.) With the testicle fully descended, hernia is more easily

excluded. To diagnose the case as acute epididymitis is the most usual mistake. In the early hours of epididymitis, before the epididymis shows much swelling, the physical signs are indeed similar. The sudden onset of an "epididymitis" in a boy or youth who shows no evidence of urethral infection is strongly suggestive of torsion. Epididymitis is seldom so excruciatingly tender during its inception.

**Treatment.**—If the case is seen within the first hour or two, an attempt may be made to untwist the cord. The testis is supported by one hand and gently rotated with the other. As one cannot be sure of the direction in which the testicle has turned, this measure does not offer much hope. It was done successfully by Nash<sup>31</sup> one hour after the onset, but atrophy subsequently occurred. When torsion occurs in an undescended testicle the gland should be removed promptly to avoid the possibility of peritonitis. With fully descended testes expectant treatment may be employed. The patient should be kept in bed, the scrotum elevated, and ice applied. Rigby and Howard followed this treatment in 4 cases. Two of the testes atrophied very little; one disappeared altogether; none sloughed. The operative reduction of the torsion with suturing of the testicle to prevent recurrence has always resulted in atrophy and seems to offer no better chances for preserving the testicle. It seems justifiable to try the expectant method for a few days, as even an atrophied testicle means more to the patient than none at all. If, however, the symptoms do not speedily subside, or if tenderness of the testicle persists, orchidectomy should be done.

## BIBLIOGRAPHY.

1. Beigel: *Virchows Archiv*, xvii, S. 144.
2. Berg: *Ann. of Surg.*, August, 1904.
3. Bevan: *Jour. Am. Med. Assn.*, 1899, xxxiii, 773-775.
4. Bevan: *Jour. Am. Med. Assn.*, September 19, 1903, xli, 718-723.
5. Broche: Quoted by Odierne and Simmons.
6. Cruveilhier: *Traité d'Anat. Path. Gén.*, vol. i, p. 301.
7. Cunningham: *Text-book of Anat.*, 1903, p. 849.
8. Cunningham: *Text-book of Anat.*, 1903, p. 1104.
9. Davison: *Surg., Gynec. and Obst.*, 1911, xii, 283-288.
10. Eccles: *The Imperfectly Descended Testis*, New York, 1903, pp. 10-12.
11. Guiteras: *Med. Rec.*, 1896, xlix, 11-13.
12. Halstead: *Surg., Gynec. and Obst.*, 1907, iv, 129-132.
13. Hanes: *Jour. Exp. Med.*, 1911, iii, 338-354.
14. Hanes and Rosenbloom: *Jour. Exp. Med.*, 1911, iii, 335-364.
15. Hempel: *Ueber Ektopia Testis*, 8°, Kiel, 1911.
16. Howell: *Am. Text-book of Physiology*, 1901, ii, 445.
17. Jacobson: *Diseases of the Male Organs of Generation*, 1893.
18. Jordan: *Deut. Med. Wchnschr.*, 1895, xxi, 525.
19. Lamb: *Proc. of the Am. Assn. of Anat.*, 1896, pp. 47-60.
20. Lane: *Brit. Med. Jour.*, 1894, ii, 1241.
21. Lenhossék: *Anatomischer Anzeiger*, 1845.
22. Lenhossék: Quoted by Halstead: *Surg., Gynec. and Obst.*, 1907, iv, 129-132.
23. Lewis and Stöhr: *A Text-book of Histology*, 1914, p. 344.
24. Lewis and Stöhr: *A Text-book of Histology*, 1914, pp. 335-341.
25. Marshall: *Edinburgh Med. and Surg. Jour.*, 1828, xxx, 172.
26. Mixer: *Undescended Testicle in Children*, *Boston Med. and Surg. Jour.*, 1916, lxxv, No. 18, p. 63.
27. Monod and Terrillon: *Maladies du Testicule*, 1879, p. 46.

28. Morris: Human Anatomy, 5th edition, p. 610.
29. Morris: Human Anatomy, 5th edition, p. 744.
30. Moschkowitz: Ann. of Surg., 1910, vii, 821-835.
31. Nash: Brit. Med. Jour., 1893, i, 742.
32. Nicolas: Thèse de Paris, 1899.
33. Ochsner: Jour. Am. Med. Assn., September 19, 1903, xli, 723.
34. Odierne and Simmons: Ann. of Surg., 1904, xi, 962-1004.
35. Pappenheim and Schwartz: New York State Jour. Med., 1910, No. 12, p. 548.
36. Popow: Bull. de la Soc. Anat., 1888, p. 653.
37. Poupart: Un Type Nouveau d'Ectopie Testiculaire, Thèse de Paris, 1897.
38. Picqué and Worms: Jour. de l'Anat., 1909, xlv, No. 1, pp. 51-64.
39. Rigby and Howard: Lancet, 1907, i, 1416.
40. Rigby and Howard: Torsion of the Testes, Lancet, 1907, i, 1415-1421.
41. Schüller: Zent. f. Chir., 1881.
42. Scudder: Ann. of Surg., 1901, xxxiv, 234-248.
43. Smith, G. B.: Guy's Hosp. Rep., 1896, liii, 215-240.
44. Summerhayes: Brit. Med. Jour., 1896, ii, 1036.
45. Terrillon and Suchard: Arch. de Phys. normale et pathologique, Paris, 1882, 2 S., ix, 325-335.
46. Thèse de Paris, 1897.
47. Van der Poel: Quoted by Rigby and Howard, Lancet, 1907, i, 1416.
48. von Bardeleben: Verhandlungen der anatomischen Gesellschaft; Anatomischer Anzeiger, 1892, vii.
49. von Ebner: Köllikers Handbuch der Gewebelehre des Menschen, 6th edition, iii, pt. 2, 451. Leipzig, 1902.
50. Whitehead: Am. Jour. Anat., 1904, iii, 167-182.
51. Whitehead: Anat. Record, 1908, ii, 177-182.
52. Wolfer: Surg., Gynec. and Obst., 1915, pp. 228-231.

## CHAPTER XIII.

### DISEASES OF THE SCROTUM.

By A. RAYMOND STEVENS, M.D.

THE most common pathological lesions of the scrotum are those inflammatory conditions secondary to diseases of the testicles, the urethra, and the rectum. These scrotal complications will be dealt with in their appropriate connections in the sections devoted to the above-named primary seats of infections.

### ANATOMY OF THE SCROTUM.

The scrotum is a loose pouch of skin investing the testicles and part of the spermatic cords. It varies markedly in size in different individuals, and with changing conditions in the same individual. In debilitated persons and the aged and from the effect of heat it relaxes and becomes pendulous; in the robust and the young and under the influence of cold, emotion, and exercise it is contracted and thicker. The layers are skin, dartos, and loose areolar tissue.

**The Skin.**—The skin of the scrotum is thin, semitransparent, and elastic, is darker in color here than elsewhere, and has a sparse growth of hair. It contains in the derma many sebaceous and sweat glands. Superficially its epidermis is similar microscopically to that over the rest of the body. Below this is the derma, rich in elastic fibers and involuntary muscle. The surface of the skin is divided into lateral halves by a slight median ridge, extending from the penis to the margin of the anus. From this, on either side, extend rugæ with a generally horizontal arrangement, determined by muscular fibers in the derma, parallel to the surface and running, as a rule, transversely.

**Dartos.**—The dartos is immediately beneath the skin and intimately associated therewith. But contrary to the statement of some anatomists, it can be dissected from the skin. The line of cleavage is proved microscopically to be between the muscle layer of the derma and that of the dartos. The dartos is a reddish-brown stratum, best developed in front and at the sides, continuous with the suspensory ligament of the penis and the superficial fascia of the abdomen, groin and perineum, and at the sides is attached to the ischiopubic rami. It is the contractile portion of the scrotum, containing connective tissue, elastic fibers, and considerable unstriped muscle, the fibers of which are placed at right angles to those of the derma. It is very vascular and entirely free from fat. The dartos forms two sacs, for the corresponding testes, and these unite in the median line to form the septum scroti.

**Areolar Tissue.**—Beneath the dartos is a very loose thin bed of vascular areolar tissue, continuous with Colles's fascia behind and the deep fascia of the abdomen in front. Scrotal hematomata are commonly situated here.

**Bloodvessels.**—The *arteries* supplying the scrotum are the external pudics (from the femoral arteries) and the superficial perineal branch of the internal pudic. The *veins* accompanying the arteries empty into the saphenous and internal pudic veins.

The *lymphatics* of the scrotum all terminate in the inguinal and femoral glands. The observations of Morley would seem to show

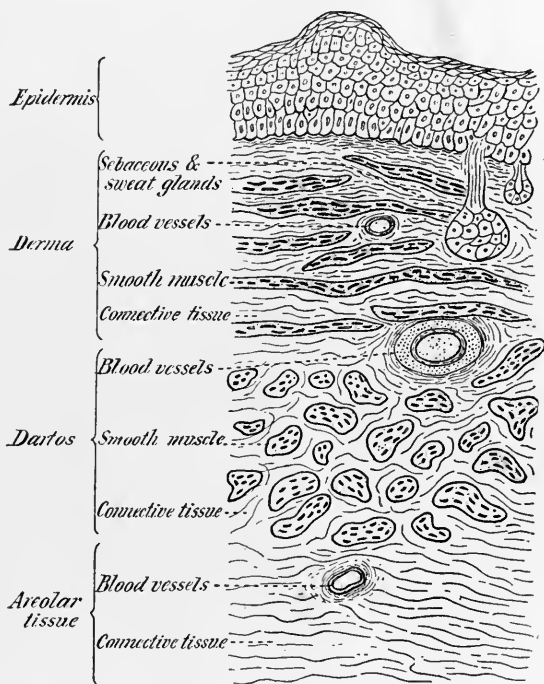


FIG. 206.—Diagrammatic section of scrotal wall.

a free anastomosis of the lymphatics of the two halves of the scrotum, a free communication of these with the lymphatics of the penis, and to a less extent with those of the thighs and perineum. The fine network between the skin and dartos empty into lymph trunks which dip at once through the dartos. There are ten to twenty main trunks on either side, which course toward the inguinal glands. It is surgically interesting that the uppermost ones may curve up 1 to 2.5 cm. on the side of the penis, thence run 1 cm. above the pubic spine, parallel to Poupart's ligament, ending in a gland sometimes only 4 cm. from the anterior superior spine. No collecting trunks are found to accompany the internal pudic vessels; and there apparently is no connection between

the lymphatics of the scrotum and those of the tunica vaginalis and testicles.

**Nerves.**—The nerves supplying sensation to the scrotum are branches of the ilio-inguinal, superficial perineal branches of the pudic nerve, the inferior pudendal (from the small sciatic), and the genital branch of the genitocrural. The sympathetic nerves accompanying the vessels supply the muscle fibers of the dartos.

### ABNORMALITIES OF THE SCROTUM.

The half of the scrotum corresponding to an undescended testicle is frequently rudimentary. In pseudohermaphroditism the scrotum is cleft, the halves resembling labia majora. Partial cleft scrotum may accompany congenital defects elsewhere in the genito-urinary system, *e. g.*, abnormalities of the penis and urethra, and ectopia vesicæ.

Abnormal pigmentation of the scrotum may be mentioned here to note that the pigment granules are placed histologically in the same location as those normally found—that is, in the deepest cells of the epidermis.

### INJURIES OF THE SCROTUM.

Stab, puncture, and gunshot wounds are subject to the same surgical consideration as similar injuries elsewhere. Growing hematomata should be freely incised, clots removed, and bleeding-points ligated. Free drainage must be established in the presence of infection or an injury to the urethra.

**Hematoma.**—Hematoma without rupture of the cutaneous surface is common, and is easily produced by blows upon the scrotum. It is important to differentiate hematocele and hemorrhage within the testicle from hematoma in the substance of the scrotal wall; the former frequently requires operation while the latter rarely does, but is best treated by rest, elevation, and cold applications, with perhaps a compression bandage.

**Loss of Substance.**—Loss of substance from accident or attempts at emasculation may lead to serious bleeding. Control of hemorrhage is of first importance, then surgical cleanliness and subsequent aseptic dressing. The reparative power of the scrotum is amazing. After the loss of over two-thirds of this tissue, leaving the testicles exposed and dangling, it is quite possible for nature to repair this vast rent and restore a satisfactory scrotum, without surgical interference. So that one method of treatment after all hemorrhage is controlled is merely to keep the raw area covered with a mildly antiseptic dressing. However, the course of such repair is slow and may be further prolonged by active fungous outgrowth of granulations from the testicles, necessitating application of the actual cautery. Better results in extensive injuries and a shorter convalescence are obtained by surgery. By loosening the skin of the inner and anterior aspects of the thighs, flaps may be cut with horizontal sides, and with the externally placed

attachments broader than the free end. These when sewed together will easily cover the testicles and form an adequate sac. In some cases, after loosening the skin from underlying tissues over a wider area, including the perineum, the edges may be apposed without actual flap formation, and with ultimately good results. If only the anterior wall of the scrotum is wanting the simplest procedure is to draw upward the remaining portion of the sac and suture it to the upper skin margin. Should the skin of the base of the penis also be trimmed away the penis may be pushed under that part of the scrotum drawn forward and brought out at a lower level. Subsequently flaps of skin from the lateral aspects of the scrotum are used to cover any raw surface on the penis.

**Suture of the Scrotum.**—As already stated, the dartos is closely attached to the skin, and its muscular fibers are generally at right angles to those in the skin. This explains the tendency of the skin edges to curl in regardless of the direction of the incision. Approximation of the skin does not necessarily include the dartos and areolar layer, and subsequently bleeding from this very vascular region may occur, forming a large hematoma. This may be guarded against by employing hemostatic sutures. Each is applied about 1 cm. from the margins of the wound, penetrating both layers of the skin and dartos, and returning in the reverse direction 1 cm. apart, the knot is tied on the side first entered. Subsequently a line of continuous sutures accurately approximates the skin edges; or both objects may be attained in a very practical way by one line of sutures, interrupted or continuous, applied about 0.5 cm. from the margins of the wound and taking each time a good bite of the deeper structures. By another method, using interrupted sutures, each stitch is carried one way through both skin and deeper structures, and returning takes only a small bite of skin. Obviously, the knot is tied on the side first penetrated by the needle.

### CUTANEOUS DISEASES OF THE SCROTUM.

Cutaneous diseases will be dealt with very briefly. Fuller discussions are readily found in works on dermatology.

**Erythema Intertrigo (Chafing).**—Erythema intertrigo affects the lateral and posterior aspects of the scrotum. It may occur at any age, but more commonly in children and fat individuals. Uncleanliness, wetness (urine or perspiration), and friction in walking are the three chief etiological factors. The treatment is simple; cleanliness, dryness, the use of a dusting powder, and a suspensory with perhaps some padding of cotton. Dermatitis or eczema may develop, requiring appropriate lotions or ointments.

**Eczema Simplex.**—Eczema simplex is said to be more frequently met with in persons of rheumatic or gouty diathesis. Its common seat is the lateral and posterior aspects of the scrotum. The lesions and symptoms are those of eczema in other parts of the body. Treatment in milder cases consists simply of support of the scrotum, avoidance of friction, and application of a dusting powder, such as the oxide or stear-

ate of zinc. Itching is relieved by 2 to 4 per cent. carbolic acid applied alone on gauze or incorporated in some simple lotion or ointment.

**Eczema Marginatum.**—Erythema marginatum is ringworm modified by erythema or eczema intertrigo, and, indeed, the parasitic nature of the affection may be obscured by these accompaniments. It occurs on the moist regions of the scrotum in patches, which present well-defined margins and elevated borders and characteristic central healing and peripheral advance. Treatment should be directed first to any associated erythema or eczema. Subsequently the affected spots are painted on several occasions with tincture of iodine; or unguentum hydrargyri ammoniati is well rubbed in daily and the applications continued some days after an apparent cure.

**Pityriasis Versicolor.**—Pityriasis versicolor occurs as yellowish-brown spots or patches on the scrotum, and is caused here as elsewhere by a vegetable parasite, *Microsporon furfur*, which attacks clean as well as dirty skins. There may be mild itching but often no symptoms exist. This vegetable growth may be made to disappear by daily scrubbing with soap and water followed by application of 25 per cent. aqueous solution of sodium hyposulphite. Recurrence is frequent.

**Pediculi Pubis.**—Pediculi pubis are sometimes found about the hair of the scrotum, usually in association with a similar occupation of the hair of the pubic region. The ova ("nits") are tightly attached to the hairs and their presence is as pathognomonic as the parasite. An eczema may coexist in the uncared-for cases. The parasite and their ova are easily killed by unguentum hydrarg., by 1 to 1000 solution of bichloride of mercury, by kerosene, or the tincture of larkspur. In patients harboring a large colony, and especially in uncleanly individuals, it is advisable first to shave all hair from the parts.

**Scabies.**—Scabies is carried to the genitalia by the hands. The characteristic "burrows" of the parasite of scabies, *Acarus scabiei*, may be seen. Numerous punctate abrasions and excoriated papules and a few crusts are often found. Itching, most marked at night, is almost invariably present. Treatment is simple and effective: a warm bath, sulphur ointment rubbed over all affected regions morning and night for several days, followed by another bath and a change to fresh clothes. A second course of treatment may be required, if a bland lotion or ointment does not clear up the skin in a few days.

**Syphilis.**—Syphilis of the scrotum is common, most frequently seen as papules, which on the moist surfaces become macerated and abraded. If untreated, they may develop papillary outgrowths, forming warty or cauliflower-like excrescences (condylomata). Ulceroeriginous lesions may develop here, and less frequently gummata or single ragged ulcers. The occasional development of chancre of the scrotum must be emphasized. Only cleanliness is necessary locally if the intensive constitutional treatment of syphilis be instituted.

**Lupus.**—Lupus of the scrotum is comparatively rare.

**Pruritus.**—Pruritus occurs with some of the above diseases and also without demonstrable skin lesions. The latter cases have frequently some constitutional debility, as gout, rheumatism, or diabetes.

Treatment is often most unsatisfactory except as affording temporary relief. One must first institute dietetic and hygienic measures aimed at fundamental constitutional disorders. Tonics or alkalies may be indicated. Turkish baths are sometimes beneficial. Locally, thymol, weak carbolic acid, or menthol in lotions or ointments and sometimes hot water relieve the symptoms temporarily.

**Sebaceous Cysts or Steatoma.**—These are formed, as elsewhere on the skin, from sebaceous glands dilated by retained secretion. Small palpable cysts of the scrotum are present in many individuals, and not infrequently isolated ones attain a diameter of 5 to 10 mm. Single cysts may occur anywhere on the scrotum; large groups are more commonly found on the anterior aspect. They are yellowish, rounded, and firm, within (not under) the skin, the larger ones protruding externally. They cause no symptoms unless infected; then they are tender and the surrounding skin is reddened. No treatment is indicated except for cosmetic results or for inflammation. They may be excised under local anesthesia; or incised, the contents evacuated, and the sac destroyed by curetting, or by cauterization—easily done with pure carbolic acid.

**Varicose Veins.**—The veins of the scrotum may show marked varicosity, which has been confused with varicose veins of the pampiniform plexus. This should not occur if careful palpation is made. However, the two conditions frequently occur together. Small telangiectatic spots may accompany the varicosity. Usually no treatment is needed. Bruyneel<sup>1</sup> reported an instance of spontaneous rupture of varicose veins of the scrotum, with loss of about 200 c.c. of blood, in a man of seventy-seven years. It is conceivable that the size of the mass may be a source of annoyance. The veins are largest in lax, elongated scroti and the easiest treatment is excision of the skin area most involved and its contained veins, careful hemostasis by ligature and proper placing of deep skin sutures.

### INFLAMMATION OF THE SCROTUM.

**Edema.**—Edema may be secondary to severe anemia and to organic disease of the heart, kidneys, or liver, and is then often part of a general anasarca. It may be due to mechanical pressure on veins or lymphatics draining the scrotal tissues, or edema may be inflammatory in origin, from infection of the testicles, perineum, groins, or scrotal wall. In every case the treatment should be directed to the primary trouble. In the edemas of systemic causation and those due to mechanical pressure, rarely are any local measures indicated other than support by strapping or a suspensory, cleanliness, and dryness of the skin. It is unusual that tension develops sufficiently to endanger the vitality of the skin. When it does so a few punctures may be made in the skin and the parts kept covered with a sterile wet dressing, and every care taken to prevent infection.

**Cellulitis and Abscess.**—Cellulitis and abscess are in the vast majority of cases secondary to inflammation of deeper structures, but may be due to infection of the scrotum *per se*. Cold, wet applications

and support of the parts will suffice for milder infections. Severe cellulitis and abscess require incision and drainage.

**Erysipelas.**—Erysipelas is most frequent in old or debilitated individuals. The onset is announced with a chill, high fever, and malaise. Locally a bright red spot develops and gradually spreads over part or all of the scrotum. The latter swells markedly, is sometimes covered with blebs, and may finally become gangrenous. On the other hand (and usually), there may be complete resolution and a return to normal. The constitutional symptoms are those of erysipelas elsewhere. Also the bacteria found here are the same as those causing the disease in other locations. It is worthy of note that in some cases resembling erysipelas of the scrotum clinically the Klebs-Loeffler bacillus has been cultivated from the wound discharge. The treatment, general and local, is similar to that of erysipelas in other regions, remembering always to keep the scrotum elevated. Numerous local applications have had a period of popularity. Cold compresses wet with boric acid solution are as satisfactory as any local treatment.

**Gangrene.**—Gangrene of the scrotum may be due to infection of deeper structures (urethra or testicles), through vascular obstruction and bacterial invasion of the scrotal wall; to primary scrotal infection (*e. g.*, erysipelas); to mechanical or chemical or thermal injury; to trophic disturbances; and to systemic conditions acting as primary or predisposing causes (diabetes, cardiovascular and renal diseases, alcoholism, general debility). Gangrene may be made of rarer occurrence by aseptic care of wounds, free incision (not too long delayed), timely surgical treatment of the deeper inflammations, and painstaking care of the medical conditions mentioned above. Treatment is logically at once directed to the underlying causative factors. Locally, incision through the dartos is to be made, and all definitely gangrenous tissue excised. Aseptic dressings are changed frequently until all evidence of active inflammation has disappeared. The testicles are never involved secondarily, and if the loss of substance has been great, are left freely exposed. Left to Nature, those large gaping wounds will heal fairly rapidly and with finally satisfactory results. But in many instances, a quicker convalescence may be had by some plastic operation (noted under Injuries).

**Emphysema.**—Emphysema is seen in connection with general subcutaneous emphysema, sometimes with scrotal gangrene or wounds in which gas-producing organisms are present. Treatment is multiple incision and free drainage in the infected cases. When an anaërobic organism is the offender, frequent irrigation with hydrogen peroxide should be done.

**Ulcerating or Sclerosing or Serpiginous Granuloma of the Pudenda.**—This is a disease of the tropics, occurring especially in the dark races, and generally contracted through sexual relations. It usually starts on the penis, as a nodular elevation of skin, very vascular and prone to break down and bleed. It extends very slowly by peripheral advance or by auto-infection of neighboring skin, especially in moist areas. The scrotum is often involved, showing a dense, uneven white or pigmented

scar within the serpiginous, raised periphery. The thighs and anal region may be involved. The lymph glands are not infected; the general health is good. It resembles lupus vulgaris somewhat, but is found only about the genitalia. The etiology is not determined. Treatment is unsatisfactory unless the case be seen early enough for excision.

**Calculi.**—Calculi of the scrotum have been described. They are calcified hematmata, true urinary calculi which have ulcerated through from the urethra, or the remnants of calcareous deposits in old urinary fistulae.

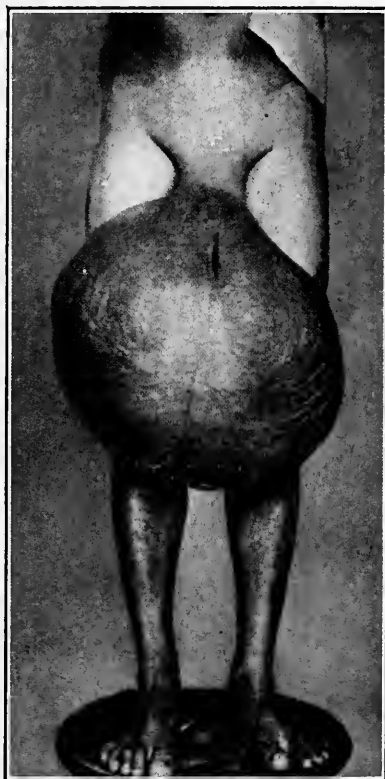


FIG. 207.—Solid form of elephantiasis. (Charles.)

#### ELEPHANTIASIS (FILARIAL) OF THE SCROTUM.

The term elephantiasis arabum is used to describe large diffuse enlargements of the scrotum, consisting of hard edema and hyperplasia of both the skin and connective tissue. While it is comparatively common in certain tropical countries, in the localities favorable for breeding of mosquitoes, it is rare in colder climates, and most of the patients seen have resided in the tropics. It is particularly prevalent in Samoa and Huahine.

**Etiology.**—The observations and deductions of competent students of elephantiasis are convincing in ascribing this condition, in at least the majority of cases, primarily to a nematode, known as *Filaria san-*

guinis hominis (or *Filaria nocturna*, or *Filaria bancrofti*). This is one of five or six filariæ found in man, and one of the two of these which are pathogenic. The larval forms frequently found in the blood are transparent, colorless, and cylindrical, 0.3 mm. long and about the diameter of a red blood corpuscle. In a fresh specimen the larvæ wiggle within encasing sheaths without changing position on the slide. They are in the peripheral blood only at night, mostly at midnight, the time of greatest activity of the mosquito. This periodicity may be reversed by having the patient sleep in the daytime. During their absence from the peripheral vessels, the larvæ are in the larger arteries, the lungs, and to a less extent in the heart muscle. Several observers have described a parasite, morphologically the same as *Filaria bancrofti*, present in peripheral blood in the daytime as well as nighttime. But this is not the rule.

The complete life-cycle involves two hosts, man and certain mosquitoes (Manson mentions eight species which may serve as intermediate hosts). The mosquito, feeding on the blood of an infected individual, takes in the larval form of filaria; these escape from their sheaths in the mosquito's stomach, and then acquire locomotion; they enter the thoracic muscles, and in the next twelve to twenty days increase in size and develop an alimentary canal and other parts; the majority reach the proboscis of the mosquito and are usually arranged in pairs. The mosquito now is capable of infecting human beings when feeding on their blood and possibly through drinking water when dying in the same. In man the filariæ soon reach the lymphatics, attain sexual maturity, and pour larvæ into the lymph, thence to the blood. The adult worms are hair-like, transparent, and 4 to 9 cm. long, the female longer than the male. The sexes live together, often inextricably coiled in lymphatics, lymph varices or glands.

Filarial disease does its chief harm through obstruction of lymphatic vessels. This may be caused by the adult worm, alive or cretified, acting as a plug, inducing thrombus formation, or inciting inflammatory thickening of the vessel wall and consequent narrowing of its lumen. The microfilariae (larvæ) have no known pathological effect, but ova have been found in the lymph, and as they are incapable of traversing lymph glands, it seems quite possible that lymph stasis may sometimes be caused by ova being lodged in the glands.

**Pathology.**—The immediate results of obstruction are lymphatic varicosities or edema, or both. These conditions are most common for obvious reasons on the lower extremities. The scrotum is involved next in frequency. Lymph varicosities of the scrotal wall cause a moderate or greater enlargement called lymph scrotum. The skin is soft and silky and on inspection presents evident varices. Microfilariae are usually present in the lymph locally. Often the inguinal and femoral glands are enlarged. Erysipelatous inflammation is a frequent complication. Lymph scrotum may remain such or become elephantiasis, which is the combined result of lymph stasis and recurrent inflammation. Lymph stasis alone causes varices and edema only. The sequence of events is lymph stasis (from causes already given),

lymphangitis, imperfect absorption of the inflammatory products, and gradual, intermittent, progressive, inflammatory hypertrophy. The derma is dense, fibrous, and enormously hypertrophied. The connective tissue is increased in bulk and has a blubbery appearance; on section there is a free oozing of lymph. Bloodvessels are enlarged and lymphatics dilated.

**Symptoms.**—Beginning as edema or lymph scrotum the scrotum is only a little enlarged. Attacks of lymphangitis with cellulitis and fever may occur. After this subsides the parts do not return quite to normal. Increased edema and recurrent lymphangitis lead to greater enlargement. The scrotum in typical elephantiasis may weigh 200 pounds (one of 224 pounds is recorded). The mass is pyriform in shape; a transverse section of the upper part is triangular with the apex toward the anus. The skin is leathery, rough and coarse, and pits little, if at all. It is thickest at the bottom, thinnest at the top, and thin and soft at the sides and posteriorly. It gradually merges all around into the healthy skin. Mouths of follicles are sometimes very distinct; the hair is coarse and sparse. The penis is at the upper and anterior part, at the bottom of a channel formed by the foreskin and skin of the penis dragged inside out by the enlargement of the scrotum. The testes are usually in the posterior part of the mass, nearer the bottom than top, each held there by its hypertrophied gubernaculum testis. The spermatic cords are thickened and very long, and hydroceles are usually present. The tumor may grow rapidly or slowly; may become enormous in two or three years or may never grow large. An attack of lymphangitis may intervene, causing painful cord-like swellings of lymph trunks and glands, with redness of the overlying skin, chill and high fever, headache, perhaps vomiting, and sometimes delirium.

The general health may be excellent except during the attacks of inflammation. The scrotum is cumbersome and unsightly and sexual relations become impossible. Gangrene may supervene; abscesses sometimes form; eczema or ulcerations may occur; and varices may rupture, allowing escape of lymph.

*Associated conditions* due to filariasis are orchitis; hydrocele; lymphangitis; abscess; varicose glands; arthritis; synovitis; elephantiasis and lymph varices elsewhere, especially in the legs; chyluria, chylocele, chylous ascites, and chylous diarrhea caused by rupture of varicose lymphatics in the urinary tract, tunica vaginalis, peritoneum and intestinal tract.

**Diagnosis.**—The larval forms of the *Filaria sanguinis hominis* are commonly present in the lymph of the varices of lymph scrotum, and may be found in the blood. Because the adult worms have usually died, it is rare to find microfilariae in the blood in elephantiasis. Indeed, in filarial countries a smaller percentage of people with elephantiasis than of those without elephantiasis have these parasites in the blood. However, they should be looked for microscopically, using thick preparations made at night. These may be studied fresh, or after being dried and stained (without fixing) for one hour in weak carbol-fuchsin (4 drops of saturated alcoholic solution to one ounce of water). In some

cases the blood shows an eosinophilia, and with the acute conditions a leukocytosis. An associated lymphangitis, with its constitutional symptoms, is suggestive. A history of residence in tropical or sub-tropical climates is generally elicited.

Lymph stasis due to other causes may give the picture of lymph scrotum and an added inflammation may cause an actual elephantiasis. However, the scrotal condition would be accompanied or even overshadowed by other symptoms, which, with the history, would lead to a correct diagnosis of syphilis, pyogenic infection, or mechanical obstruction of the lymphatics.

**Prophylaxis.**—The life-cycle of the *Filaria bancrofti* can be completed in neither man nor mosquito, but only by passage of the parasite from one to the other. One human being cannot contract filarial disease from another, but becomes infected only by the form of the parasite developed in the mosquito. Prevention of filariasis and its many consequences hinges on the elimination of the mosquito. Its breeding places should be dealt with according to methods now generally known in civilized communities. Individuals harboring filariæ and all uninfected people in tropical climates should be carefully protected from mosquitoes. It is possible, though not proved, that water to which mosquitoes have had access may convey the parasite. Hence all drinking water in the tropics should be boiled.

**Treatment.**—While simple lymphatic edema may subside it seems generally recognized that lymph scrotum and elephantiasis do not recover spontaneously. They remain stationary for years or recede somewhat in bulk after an attack of lymphangitis, but such scrota never again become normal.

The cure of filariasis involves the destruction of the adult parasites. No known drug is efficient to this end. The worms often die after plugging a lymph trunk, especially after lymphangitis, and thus a spontaneous cure of the active infection may occur. But the numerous sequelæ of the obstruction remain. When the site of the entrapped worm is surgically accessible, operation may really cure the disease. But the location of the parasite cannot often be diagnosed during life. When scrotal involvement is the only sign of filariasis it seems probable that the worm is in the inguinal glands. Primrose<sup>16</sup> reported a case cured clinically and according to blood examination by surgical removal of part of the scrotum in which the adult worm was found. Cunningham<sup>5</sup> operated for elephantiasis, did not find any filaria in the specimen removed, but larval forms were found in the blood before operation and none afterward; the patient was clinically well at the end of twenty months when the case was reported and has remained well since.

Lymph scrotum should be kept clean and dry and a well-fitting suspensory worn. Chyluria and elephantiasis of the leg have followed surgical intervention. If anything is attempted, a complete excision is the best procedure.

Lymphangitis and fever are treated by confining the patient to bed, elevating the scrotum, and applying ice-bags or, better, cold compresses. Morphine may be necessary to relieve pain. The bowels are kept open, light diet given, and a copious quantity of water should be taken.

Elephantiasis of the scrotum, if small and not burdensome, had better be merely guarded against injury, or perhaps bandaged tightly. If large, excision is not only feasible but advisable. In parts of India this is one of the commonest of operations. One surgeon reports having removed "over a ton" of scrota! The immediate and remote results are good as regards comfort and sightliness and the patient's working efficiency. Attacks of fever often cease after operation. Coitus and procreation become possible. The general mortality of the operation is a trifle over 5 per cent. Charles,<sup>4</sup> Maitland,<sup>11</sup> Murray<sup>15</sup> and Calvert<sup>3</sup> have reported (totaling their cases) 560 operations of excision of the scrotum for elephantiasis with only 6 deaths. Charles had a series of 140 consecutive unselected cases without a death and Calvert a series of 151.

The operation is preceded if possible by elevation of the scrotum (sometimes with compression as well) and frequent cleansing for two or three days. Erosions or ulcerations of the skin should be healed before operation. The usual preoperative preliminaries of examination and preparation are to be observed. The patient is placed in the lithotomy position. A figure-of-eight tourniquet (around waist and base of scrotum) may be used to control bleeding; some operators of large experience advise against it. The incisions outlining the tissue to be removed must all be made in healthy skin. Three primary incisions are made: one in the median line from near the pubis to the preputial orifice, through which the penis is freed by the finger, and two over the cords, and far enough into the scrotum to permit of liberating the testicles, cutting of the gubernaculi, and delivery from the wound of cords and testicles. Then follows the complete excision, of the diseased tissue. Care is needed to avoid the dorsal vein of the penis, and also the bulb of the urethra, which is pulled downward by the mass. Hemorrhage is controlled more by torsion than by ligature. The skin of the inner aspects of the thighs is dissected free and the two edges sewed together after placing the testicles on the perineum beneath the flaps thus obtained. Perineal drainage is employed. The skin about the penis is sutured to the tunica albuginea (not the connective tissue) while the penis is held extended, avoiding suturing over the urethra. If the foreskin be the least involved, trim it off close to the glans penis. If healthy, save it and stitch to the tunica albuginea. The raw surface of the penis is covered at once with Thiersch grafts obtained from the thigh. Hydroceles are usually encountered and are dealt with by excision of the sacs. Varicocele may be excised. Inguinal herniæ are occasionally found, and are subjected to radical cure if the patient's condition permits. Castration is advisable if the testicles are infected or entirely atrophied. Two cases of concomitant epithelioma of the penis have been reported in the literature. This condition would necessitate, in addition to the scrotal operation, amputation of the penis and careful dissection of the inguinal groups of glands.

The knees are kept tied together for some days after operation. Annoying erections are best controlled by an ice-bag.

Wise and Minett<sup>12</sup> in enumerating the situations where adult filariæ,

alive or cretified, have been found, report them in the inguinal glands in 25 cases. This would make it appear wise to remove the inguinal glands of patients who are in good condition if there be larvæ present in the blood before operation and elephantiasis of the scrotum is the only other evidence of filariasis.

Kondoleon<sup>8</sup> has recently advised in cases of edema of the scrotum and early elephantiasis, incision of the skin over both testicles, excision of a strip of fascia 3 or 4 cm. broad, incision and turning back of the tunicæ vaginalis as for hydrocele, and suture of the skin without drainage.

Castellani<sup>12</sup> has recommended daily injections of 2 c.c. fibrolysin for fibromatosis of the legs. But there would appear little use for this method in the scrotum, where radical operation is so efficient.

**Elephantiasis of Non-filarial Origin.**—Elephantiasis of non-filarial origin represents sporadic cases of unknown etiology in patients who have not visited the tropics. Instances have been mentioned in which the condition was due to the blocking of the lymphatics by a scar, or by infection, or after operative removal of the inguinal glands with, of course, a supervening infection in the scrotal wall. A slight degree of elephantiasis may occur with ulcerating granuloma of the genitalia. A similar condition is referable to tertiary syphilis in rare cases. A convincing report of such a case was made by McDonagh;<sup>10</sup> the scrotum measured 28½ inches in circumference, and was reduced by mercurial treatment to 13½ inches.



FIG. 208.—Cancer of the scrotum.

### NEOPLASMS OF THE SCROTUM.

New growths of the scrotum are relatively uncommon. The least uncommon and most important is epithelioma, known as chimney-sweep's cancer. It is a rarity in America but more frequently met

with in England. Morley<sup>14</sup> found records of 30 cases at the Manchester Royal Infirmary from 1906 to 1910, and (for comparison) only 25 of carcinoma of the penis. It was seen in former days chiefly among chimney-sweeps, and nowadays is particularly found among workers in paraffin and other coal-tar products. Butlin<sup>2</sup> showed years ago by very interesting statistical data that the irritation of soot and coal-tar products was a marked predisposing etiologic factor.

Cancer begins in the form of one or more warts, apparently remaining benign for years; or as a superficial, painful, ragged, vascular ulcer with hard base and edges with a scab on its surface, situated usually on the lower part of the scrotum. Pathologically this is a true epithelioma. Clinically it is slow growing, and the glandular involvement is relatively late. Metastasis to other organs is uncommon. If untreated the growth may gradually involve testicles, perineum, and penis. The treatment is thorough excision of the scrotum and enucleation of the inguinal and femoral glands, preferably in one mass (see paragraph on Lymphatics of the Scrotum). Unless adherent the testicles and cord should not be removed.

Adenocarcinoma metastasis in the scrotum has been reported. Primary melanosarcoma is of rare occurrence. Instances of angioma; lymphangioma, fibroma, lipoma, chondroma, osteoma, hydatid cyst, atheromatous cyst, and dermoid cyst of the scrotum, have been recorded.

#### BIBLIOGRAPHY.

1. Bruyneel: Un cas de rupture de varices du scrotum, *Bull. Soc. de méd. de Gand*, 1908, lxxv, 106.
2. Butlin: Cancer of the Scrotum in Chimney-sweeps and Others, *Brit. Med. Jour.*, 1892, i, 1341; ii, 1.
3. Calvert: The Operation for Removal of Elephantiasis of the Scrotum and Penis; Notes on Two Hundred Consecutive Cases, *Indian Med. Gaz.*, Calcutta, 1905, xl, 161-163.
4. Charles: The Surgical Technic and Operative Treatment of Elephantiasis of the Generative Organs, Based on a Series of One Hundred and Forty Consecutive Successful Cases, *Indian Med. Gaz.*, 1901, xxxvi, 84.
5. Cunningham: Filariasis, *Ann. Surg.*, October, 1906, p. 481.
6. Daniels and Wilkinson: *Tropical Medicine and Hygiene*, 1909.
7. Greene: Cancer of the Scrotum, *Boston Med. and Surg. Jour.*, 1910, elxiii, 755, 792.
8. Kondoleon: Die Lymphableitung des Scrotum, *Zentralbl. f. Chirurgie*, Leipsic, September 26, 1914, xli, No. 39, 1513.
9. Kuhn and Gühne: Zur operativen Behandlung der Elephantiasis Scroti, *Archiv f. Schiffs. u. Tropen-Hyg.*, Leipzig, 1913, xvii, 457.
10. McDonagh: Case of Syphilitic Elephantiasis of the Scrotum, *Proc. Roy. Soc. Med.*, London, 1911-1912, v, *Dermat. Sect.*, 67.
11. Maitland: The Operation for Removal of Elephantiasis of the Scrotum and Penis, *Indian Med. Gaz.*, 1901, xxxvi, 161.
12. Manson: *Tropical Diseases*, 1914, 5th edition.
13. Matas: The Surgical Treatment of Elephantiasis, etc., *Am. Jour. Trop. Dis.*, New Orleans, 1913, i, 60-85.
14. Morley: Lymphatics of the Scrotum in Relation to Radical Operation for Scrotal Epithelioma, *Lancet*, 1911, ii, 1545.
15. Murray: Elephantiasis of the Scrotum and Penis, *Indian Med. Gaz.*, 1902, xxxvii, 457.
16. Primrose: Filariasis in Man Cured by Removal of Adult Worms in an Operation for Lymph Scrotum, *Canada Prac.*, Toronto, 1905, xxx, 135-146.
17. Whiting: Gangrene of the Scrotum, *Ann. Surg.*, Philadelphia, 1905, xli, 841-862.

## CHAPTER XIV.

### HYDROCELE, HEMATOCELE AND VARICOCELE.

By HENRY L. SANFORD, M.D.

#### HYDROCELE.

**Definition.**—Hydrocele in its ordinary form is an abnormal accumulation of serous fluid in the cavity of the tunica vaginalis. Normally a few drops of fluid are present between the visceral and parietal layers of the tunica as a protection to the testis.

Other forms of hydrocele represent collections of fluid contained in other structures than the cavity of the tunica vaginalis, either communicating with it or distinct from it. A brief reference to the embryological development of these structures will aid in explaining the origin of these other types.

**Anatomy.**—Before its descent into the scrotum the testis is a retro-peritoneal abdominal organ and has no direct relation with the true abdominal cavity. As it descends on the gubernaculum testis it carries with it the anterior covering of peritoneum, which is to become the visceral layer of the tunica vaginalis, and as the testis passes through the internal ring and the inguinal canal it pushes before it a pouch of parietal peritoneum which is called the processus funicularis, and which in turn becomes the parietal layer of the tunica vaginalis.

In the scrotum the visceral layer of the tunica, after covering the testis, passes over onto the epididymis, which it includes between its two leaves, and is then reflected onto the parietal layer of the tunica. It thus happens that the posterior inner border of the testis where it is apposed to the epididymis has no peritoneal covering, and so it maintains its original retroperitoneal character.

After this complicated migration of the testis is completed a door is shut after it to hold it in position. If this door does not close soon after birth or, in other words, if the cavity of the funicular process of peritoneum through which the testis descended does not become obliterated, conditions are present which admit of various abnormalities. Among them are some of the types of hydrocele to be considered.

**Varieties.**—Hydroceles may be classified\* according to their anatomical location into:

1. Hydrocele of the testis.
2. Hydrocele of the cord.
3. Complications of 1 and 2.
4. Hydrocele of a hernial sac.

\* Jacobson's Classification.

1. *Hydroceles of the testis include* (A) those of the *tunica vaginalis*, where the fluid is in a sac directly connected with the *tunica vaginalis*. Of these there are four forms:

(1) The *ordinary* type, distending the closed *tunica vaginalis*;

(2) The *congenital* type, where the sac of the *tunica vaginalis* communicates directly with the abdominal cavity, due to complete failure of the *processus funicularis* to close;

(3) The *infantile* type, in which the sac of the *tunica vaginalis* and a portion of the *processus funicularis* are filled with fluid, but no connection exists with the abdominal cavity, representing partial failure of closure of the *processus funicularis*; and

(4) The *inguinal* type, a hydrocele in relation to an undescended testis.

(B) *Encysted hydroceles of the testis*, in which the fluid is in a sac distinct from the *tunica vaginalis*, as in *encysted hydroceles of the epididymis* when the fluid is contained between the two layers of visceral tunica as it passes from the testis over onto the epididymis, and *encysted hydroceles of the testis*, where the fluid is between the *tunica albuginea* and the visceral layer of the tunica. These are rare types.

2. *Hydroceles of the cord* may be of the *diffused* type, a serous collection of the nature of edema in the cellular tissue of the cord, or of the *encysted* type, fluid in a distinct sac originating either from some unobliterated portion of the *processus funicularis*, or from a cyst formed independently of this process, by dilatation of persistent tubules of the organ of Giraldes.

3. *Complications* of these forms of hydrocele represent any two forms coexisting or any form occurring with hernia.

4. *Hydrocele of the sac of a hernia* may occur by the effusion of fluid into a hernial sac, the contents of which have been reduced with subsequent obliteration of the neck of the sac.

Hydroceles may also be considered according to their course as *acute* and *chronic*, and as to their origin as *symptomatic* and *idiopathic*. While all idiopathic hydroceles are chronic it is not equally true that all symptomatic hydroceles are acute.

**Acute Hydrocele.**—Acute hydrocele is the direct sequel of inflammation and infection of the testis and epididymis and occasionally follows trauma. The cavity of the *tunica vaginalis* is filled with a varying amount of fluid which may be *serous*, *fibrinous*, or *purulent*. Gonorrhea and tuberculosis of the epididymis are the two infections which most often produce symptomatic hydrocele, the former a very acute type, the latter tending to a more chronic course. Other causes which may produce this form of hydrocele are infections by the pneumococcus, the colon bacillus, by typhoid, erysipelas, rheumatism, syphilis, and neoplastic growths.

**Course.**—The course of acute hydrocele corresponds to that of its cause: it tends to recovery as the primary disease improves and becomes chronic as the cause persists. The exciting factor may entirely disappear, however, and leave behind it a persistent hydrocele.

**Symptoms.**—The symptoms of acute hydrocele depend on the virulency of the infecting agent. *Pain* may be severe or absent. In acute gonorrheal epididymitis the tension of the complicating hydrocele is often responsible for a considerable part of the severe pain, as is shown by the remarkable relief which follows the release of the fluid in epididymotomy. The hydrocele accompanying tuberculous epididymitis on the contrary rarely causes any discomfort. The *sac* of an acute hydrocele may be *obliterated* by plastic exudate, or *suppuration* may occur in it.

**Diagnosis.**—The diagnosis may be made by the means to be described under the chronic type.

**Treatment.**—The treatment is usually *palliative*. If the causative infection runs a short, acute course, and the amount of fluid is small, with *rest*, *elevation* of the scrotum and *hot, moist dressings*, the effusion may be left to absorb. Severe pain with considerable fluid demands *aspiration*, which may be repeated if necessary.

*Suppuration* requires *incision* and *drainage*. None of these measures are curative, and the treatment of the underlying condition is the proper treatment for the hydrocele. Injection of the sac is usually unsuccessful in this type of hydrocele, and should not be done. When the fluid fails to be absorbed after some weeks, the hydrocele becomes chronic.

**Chronic or Idiopathic Hydrocele.**—**Etiology.**—Persistence of an acute hydrocele is a common cause of the chronic type. This occurs especially after infections of the testis and epididymis which tend to run a chronic course. Cases of *primary disease of the tunica vaginalis* have been reported as the cause of chronic hydrocele without being secondary to diseases of the testis or epididymis. Hildebrand<sup>4</sup> described a gumma of the tunica vaginalis and De Vlaccos<sup>4</sup> two cases of tuberculosis of the tunica. The latter considered the hydrocele analogous to a tuberculous ascites, and believes that the tuberculosis originated in the abdomen, with transmission of infection through an open processus funicularis, settling at its lowest point.

*Trauma* is considered a cause of chronic hydrocele. In this way the frequent occurrence of hydrocele among circus-riders is explained. Injuries at birth have been held responsible for certain instances of congenital hydrocele.

Besides all these cases, however, to which an etiological factor may be assigned, there still remain a large number of hydroceles the cause of which is not known, and to which the term *idiopathic* is given. These cases are seen frequently in tropical countries, especially India and Egypt, and various investigators have adduced different reasons for their occurrence. Madden<sup>1</sup> believes this type is due to loose tropical clothing, which allows greater trauma to the testis, and to oriental sexual excesses, both of which tend to hyperemia and serous exudate. Pfister<sup>1</sup> thinks there is a connection between bilharzia and hydrocele, while Salm<sup>1</sup> claims to have found filarial embryos in six out of twelve East Indian hydroceles. Others have not confirmed this. Some chronic irritation of the local circulation is believed by many to be the probable causative factor.

Chronic hydrocele differs from varicocele in that it shows no predilection for either *side*, and it often is *bilateral*. All *ages* are subject to hydrocele. Posner,<sup>24</sup> however, is impressed with the number of hydroceles he has met with in old men in association with prostatic hypertrophy, and believes it is a possible cause of the *idiopathic* type.

**Pathology.**—The pathology of hydrocele involves a study of the *fluid*, the *sac*, and the *effects*, if any, of the presence of the hydrocele on the *testis* and *epididymis*.

**The Fluid.**—**Amount.**—The hydroceles one sees today contain from 4 to 10 ounces of fluid. Patient, un'ess they come from remote districts, rarely allow them to get larger without seeking relief. Before the days of surgical asepsis, operations were regarded with considerable dread, and cases of enormous size are on record. Mursenna (1796) reported a case where the sac measured 17 by 27 inches; Leigh, in 1607, one where the tumor weighed 120 pounds, and Casper, a case in which the sac held 5 gallons.



FIG. 209.—Idiopathic hydrocele.

**Physical and Chemical Properties.**—Hydroceles in simple uninfected cases contain a clear serous liquid resembling blood serum. It is of a straw or greenish-yellow color; the reaction is neutral; its specific gravity varies from 1020 to 1026, and it has no odor. The fluid is cloudy if infected, and may be brownish red with a coffee-ground sediment in case of old hemorrhage. It contains about 6 per cent. of albumin, made up of serum albumin and globulin with some fibrinogen. Glucose has been found in it. It differs from ascitic fluid by containing salts and fibrin. Occasionally on opening a hydrocele there are found in the fluid *fibrous bodies* about the size of a pea which are concretions of earthy phosphates or carbonates covered with fibrin. Keyes<sup>15</sup> believes they probably originate as deposits of hydrocele salts on some warty growth on the sac wall, which later breaks off and becomes free in the fluid.

*Microscopic examination* of the fluid shows some endothelial cells, a few leukocytes, cholesterin crystals, and in many cases spermatozoa. Bacteria are present in infected cases, and blood if there has been spontaneous or traumatic hemorrhage from the sac wall or testis. There are often seen glistening drops which have been considered fat drops but which Posner<sup>24</sup> thinks are lipoids, analogous to the lecithin bodies of the prostate. He believes these bodies impart motility to the spermatozoa, as does the lecithin of the prostate. The presence of spermatozoa is explained by the supposition that a rupture of semen-preparing tubules has occurred into the hydrocele sac and that a communication between these tubules and the sac must continue to exist. If this is true the cholesterin crystals found in hydrocele fluid may be accounted for as coming direct from the testis.

From Caforio's<sup>5</sup> study of hydrocele fluid he believes it to be an *exudate* of bacterial origin rather than a transudate from chronic passive congestion, otherwise he would expect hydrocele more often to complicate varicocele, and *vice versa*. He finds also that transudates in general have a lower specific gravity and smaller albumin contents than hydrocele fluid.

*The Sac.*—The cavity of the sac in hydrocele may be *single* or *multilocular*. Adhesions between the layers of the tunica may be formed as a result of fibrinous exudate subsequent to infection or irritant injections producing partial obliteration. In hydroceles of long standing the sac wall is usually much thickened. This appears especially about points of puncture from previous tapping. Calcification may occur in localized areas.

*The Testis and Epididymis.*—Primary disease of these organs in many cases is the cause of the hydrocele, but they may also suffer as a result of the presence of the hydrocele. Pressure of the fluid on the testis and thickening of the connective tissue about it has produced atrophy and loss of function of the organ. The epididymis may also be involved.

*Symptoms.*—The *objective* symptoms of hydrocele are those of a pear-shaped tumor of one or both sides of the scrotum, the larger portion below, and the smaller above, sharply tapering into the cord. It is smooth in outline, elastic to the touch, dull to percussion, and translucent to light. It cannot be reduced into the inguinal canal, and gives no impulse on coughing unless complicated with hernia. In hydroceles of large size the skin of the scrotum is tense and glazed, but shows no redness or edema and is movable over the tumor. The cord leading to the hydrocele is normal in size. The growth of the tumor is slow, enlarging gradually from the bottom of the scrotum toward the inguinal canal. The testis is usually situated behind and somewhat below the centre of the tumor; very rarely it is at the front, and then only as the result of adhesions.

*Subjectively* chronic hydroceles rarely cause any pain or tenderness unless some complicating infection is present. The fluid gathers slowly and may reach some size before the patient notices it. Hydro-

celes do, however, produce discomfort from their weight, and if of a large size, invagination of the penis into the encompassing tumor makes urination difficult with attendant excoriation of the skin by the urine. Coitus may be interfered with either because erections are poor or because the outflow of semen is obstructed. Cases are on record in which spermatozoa were absent in the semen when the hydrocele was distended, but reappeared after tapping. Prostatics who have hydrocele are sometimes hard to catheterize.

**Diagnosis.**—*The Light Test.*—The property possessed by simple hydrocele of transmitting light through its fluid contents is the means most often invoked in making a diagnosis. If the observer looks through a hollow tube held tightly against one side of the hydrocele, while an electric light bulb or other source of light is held against the



FIG. 210.—Hydrocele. Diagnosis by transillumination.

opposite side, a pinkish light will be seen glowing through the tumor and a darker shadow cast by the more solid testis may sometimes be made out. This test often fails when the contents of the hydrocele are cloudy, when its walls are thickened, and in the presence of adhesions or multilocular cyst formation. Translucency is also a characteristic of some soft tumors of the testis when a portion of the contents is fluid; it is observed in some hernias in infants and in some hydatid cysts. This method of diagnosis therefore is by no means infallible.

Unless it extends up into the inguinal canal a hydrocele is *sharply defined* at its *upper border*, into which the cord of normal size passes.

*Puncture* of the hydrocele and recovery of the typical fluid is the surest means of diagnosis. It should never be done, however, unless the presence of hernia can be absolutely ruled out.

A *cytological examination* of the aspirated fluid does not always give an idea of the causative factor of the hydrocele, but many authors are agreed that the presence of a large percentage of mononuclear leukocytes is strong evidence of a *tuberculous* hydrocele.

Besides these methods, the history of the slow gradual development of a painless tumor is of aid in making a diagnosis.

**Differential Diagnosis.**—Hydrocele must be differentiated from hernia, spermatocele, hematocele, chylocele, and solid tumors of the testis.

*Hernia* give an impulse on coughing, is tympanitic to percussion and is reducible unless incarcerated or strangulated. In the latter case the previous history of a reducible tumor with the recent acute symptoms would prevent confusion in diagnosis. It must always be remembered, however, that hydrocele and hernia often coexist, especially in children.

*Spermatocele* is differentiated by its rarity, by the fact that the testis is usually in front and below, instead of behind as in hydrocele, and by the predominance of seminal elements in the fluid contents on aspiration. The differential diagnosis is impossible, however, in the intravaginal type of spermatocele, which can only be identified at operation.

*Hematocele* can usually be distinguished by the recent history of injury, by its solid and inelastic feel, by the opacity of its contents, and by the presence of skin ecchymoses. A hydrocele may be converted into a hematocele by spontaneous or traumatic hemorrhage from the sac wall, the latter sometimes follows aspiration of a hydrocele, if the trocar wounds a vessel in the sac.

*Chylocele* is characterized by its occurrence in the tropics, its parasitic origin, and by the creamy character of the fluid, which shows a layer of fat at the top on settling.

*Solid tumors of the testis* differ from hydrocele in their rapid growth associated with pain, in their non-elastic feel, with absence of fluctuation, and the development of inguinal glands. There is frequently enlargement of the cord leading to the growth.

**Prognosis.**—In *children* cures of hydrocele may occur spontaneously and occasionally after a single tapping. For this reason certain authors advise expectant treatment with children. Other authors find hernia complicating hydrocele in infants so frequently that they recommend early radical cure of both conditions.

In *adults* chronic hydrocele shows no tendency to spontaneous recovery. It never endangers the patient's life except under the rarest complications of hemorrhage and infection. The percentage of cures under the various methods of treatment is discussed under that heading.

**Complications.**—Two or more forms of hydrocele may coexist, and hernia frequently accompanies hydrocele in children. *Suppuration* is uncommon in chronic hydrocele. *Rupture* of the hydrocele sac is usually regarded as rare, but Hastings<sup>13</sup> believes it a more frequent accident than is commonly supposed. It may occur as the result of trauma or muscular action, rarely spontaneously. The tunica vaginalis in such cases is nearly always the seat of pathological changes, usually with fibrous thickening, and areas of fatty degeneration. A ruptured

hydrocele must be differentiated from elephantiasis of the scrotum, from extravasation of urine, and from strangulated hernia. *Hematocele* may be the result of the rupture of the sac. Rupture only rarely results in a cure, usually the hydrocele refills, unless the cavity of the sac is filled with blood clots.

**Treatment.**—*Historical.*—There is scarcely a disease for the cure of which physicians for centuries have devised more numerous or more ingenious methods of treatment, than for hydrocele. Until anatomists of the time of Monro, Hunter and Pott discovered the true nature of hydrocele, there was “supposed to be an immediate connection between the coats of the testicle, liver, kidneys, and other viscera, and the collection of water in hydrocele was considered a deposition from these parts, tending to free them and perhaps the system at large from diseases of importance.” Various kinds of *internal medication* were accordingly used, with *local applications* in the form of counter-irritants. Simple *tapping* of the hydrocele was a very early measure. *Electricity* and *electropuncture* were employed, on the principle that the current acted as a counter-irritant and also possessed some coagulating power on albuminous fluids. The *injection of irritant fluids* into the sac following aspiration was among the earliest methods of treatment, and is still used today. Among the fluids which have been used are wine, various acids, iodine, chlorine, zinc chloride, alcohol, ether, chloroform, adrenalin, bichloride of mercury, ferric chlorate, chloral hydrate, ergotin, and silver nitrate. The *introduction of foreign bodies* into the sac after aspiration has also been extensively practised with the idea that the injection of an irritant fluid had too transitory an effect to produce complete obliteration of the sac. Some of the substances used have been rubber tubes, silk, catgut,<sup>30</sup> and metal strips.<sup>17</sup>

*Vaccine therapy* has been used in hydrocele. Mallanah<sup>16</sup> reports cures of six cases in which an injection of from five to ten mill'on of either B. pyocyaneus or Staphylococcus aureus vaccine was made into the hydrocele sac after aspiration of the fluid. Severe reaction occurred, followed by increase in size of the hydrocele, later regression to a cure.

*Autoserotherapy* in the treatment of hydrocele consists in total or partial aspiration of the sac, followed by subcutaneous or intramuscular injection of the patient with his own fluid. This has been extensively practised in recent years by foreign investigators, but there is little American literature on the subject. This method is analogous to similar work which has been done in tuberculous exudates of the pleura and peritoneum. The amount of fluid injected varies with different workers from 1 to 20 c.c. with an average dose of 5 c.c. The size of the dose is reported to make little difference in the amount of local reaction or the effect on the hydrocele. Injections are made either in the thigh, buttock, or abdomen. Most authors who have tried this procedure have reported a rapid absorption of the fluid in the hydrocele following the autoserotherapy. The absorption takes place within the first twenty-four hours and then remains stationary. There is seldom local

reaction or fever. In most cases relapses occur, sometimes immediately but not later than two months. These cases require several reinjections.

In 73 cases Caforio<sup>6</sup> reports that absorption of the fluid in the hydrocele took place in 96 per cent. Relapses occurred in 80 per cent. but by continuing the injections 42 per cent. were permanently cured, as shown by absence of relapses over periods varying from several months to years. The injection of hydrocele fluid from other patients (heteroserotherapy) produced no effect. Investigators are not agreed as to how this method produces the results claimed, and until the nature of the process involved in the cure is better understood, it must be regarded as only in the experimental stage.

*Radical surgical operations* on hydrocele have been done for centuries. Incision and drainage of the sac was practised as early as the time of Celsus, who also excised a portion of the skin at the same time. But the tremendous reaction resulting from the infection of the wound made surgery the resort of the more adventurous until the days of cleaner methods.

When Lister introduced the principles of antiseptis, hydrocele was one of the first diseases on which their value was demonstrated. Volkmann, in 1876, gave his name to an operation which consisted in wide *incision* of the sac, swabbing its cavity with carbolic acid and sewing the edges of the sac to the skin with catgut. Permanent drainage was thus secured until obliteration of the sac by granulation took place. Von Bergmann, in 1885, was one of the first to practise *excision* of the sac. Since that time many surgeons have devised changes in the technic of the handling of the sac, and in providing a new bed for the testis.

**Present Methods of Treatment.**—The methods of treatment which need concern us seriously today are two:

1. The purely *palliative* procedure of tapping or *aspiration*, and
2. The radical operations which seek to obliterate or remove, wholly or in part, the membrane which secretes the serous fluid. These are of two types: (a) The *closed operation* of *aspiration and injection*, and (b) the *open operations*, consisting in total or partial *excision*, or *eversio*n of the sac, or a combination of the two.

**SIMPLE TAPPING.**—*Indications.*—Aspiration of the fluid of a hydrocele does not contemplate a cure but merely the relief of symptoms. It is employed when the patient will not consent to a more radical procedure or when some constitutional condition contra-indicates any operation. It may be used to advantage in children when the hydrocele is uncomplicated, and at times results in a cure.

*Technic.*—After proper preparation of the skin and after locating the position of the testis the hydrocele is made tense by grasping it from behind between the palm and fingers of one hand. A spot free from large bloodvessels on the lower tense anterior surface of the hydrocele is selected and a sharp medium-sized trocar plunged smartly and quickly into the sac, using one finger firmly fixed on the trocar about one-half inch from its point as a guard against too deep penetration. With a

sharp instrument the pain of puncture is slight and only momentary, and often no local anesthetic is needed.

On withdrawing the needle from the trocar, if the fluid does not run through the cannula, it generally means that the point of the trocar has pierced only the skin and not the tunica vaginalis, so that farther insertion is necessary. Care must be taken not to let the cannula slip out of the cavity of the tunica vaginalis into the space between it and the skin during the withdrawal of the fluid, as this results in infiltration of the scrotum. A collodion dressing of the puncture wound and a suspensory complete the aspiration.

In old men with large hydroceles a partial removal of the fluid is wise, followed later by withdrawal of the remainder. Congestion and hemorrhage have been reported following too great changes in local conditions after the complete aspiration of a large sac.

After tapping, the hydrocele usually refills in from two to six months. Many patients are content with a semi-annual relief of their burden over a period of many years.

*Complications.*—The trocar may wound the testis when it has been pulled out of its usual posterior position by adhesions. This rarely produces any serious trouble. Hemorrhage from the sac wall due to puncture of a vessel of some size by the trocar may produce hematocele. Both of these accidents may be avoided by transillumination of the sac in selecting a point of puncture. The course of bloodvessels and the position of the testis are thus made clear.

*ASPIRATION AND INJECTION.*—This ancient method of treatment is still in considerable use today. It seeks to produce obliteration of the cavity of the tunica vaginalis by the injection into it of an irritant following the aspiration of the fluid. The drug which has proved the least painful and the most sure in its results as an injection is carbolic acid.

*Indications.*—This procedure is indicated in a restricted class of cases, namely, in simple uncomplicated hydroceles when the fluid is clear and the sac wall unchanged. It is not adapted for congenital hydroceles, for symptomatic hydroceles with accompanying disease of the testis or epididymis, for hydroceles in which the sac wall is indurated, infected, or calcareous, for multilocular hydroceles, nor for hydroceles complicated with hernia.

*Technic.*—A hypodermic needle detached from its syringe is inserted into the upper portion of the hydrocele sac, and after the escape of fluid through the needle shows that it is in the sac it is left in position while the hydrocele is completely aspirated to the last possible drop by a trocar introduced into its lower anterior portion. The trocar is then withdrawn and a hypodermic syringe containing from 5 to 20 minims of pure carbolic acid crystals, deliquesced by heat, is attached to its previously inserted needle. The acid is then injected into the sac and the scrotum thoroughly kneaded in order to spread the acid through the sac cavity. Care should be taken not to burn the scrotum by spilling any of the acid; alcohol will neutralize the effect of any that might

escape. Both puncture wounds are sealed with collodion, and a snug suspensory applied.

Some authors advise washing out the sac after aspiration with sterile salt solution until the wash water returns clear, in order to remove as much albuminous material from the sac wall as possible and to prevent it from neutralizing the effect of the acid. Keyes<sup>15</sup> has failed to note any advantage in this method.

Pain is inconsiderable owing to the anesthetic effect of the carbolic acid. Confinement to bed is not necessary after the injection, though usually patients remain quiet one or two days.

After the injection the sac partially refills with inflammatory exudate over a period of a week or ten days, after which it usually begins to recede. If still large and tense at the end of that time the sac should be emptied again by aspiration without a second injection. If it then refills for a second time the case is not suitable for injection and open operation is indicated.

Keyes believes that failures of the injection method are due to three causes: (1) improper selection of cases; (2) errors of technic, as incomplete evacuation (the most frequent cause of failure) and failure to aspirate a second time, which is sometimes part of the cure; (3) the use of iodine instead of carbolic acid, the former being more painful and less certain in its results.

**OPEN OPERATIONS.**—*Indications.*—One of the many variations of open operation may be performed in any type of hydrocele except in those cases in which the patient's preference or condition allows of palliative treatment only. Open operation is especially indicated, moreover, in those forms of hydrocele mentioned above in which the injection treatment is contra-indicated or likely to fail. It gives the operator the additional advantage of examining the testis and epididymis for the presence of pathological changes, with the opportunity for appropriate treatment.

*Technic.*—Local or general anesthesia may be used. After proper preparation of the parts a high incision, three or four inches in length, according to the size of the hydrocele, is made, beginning over the external abdominal ring and extending downward along the course of the cord. The tunica vaginalis is exposed and the subsequent steps differ according to the type of operation to be done.

**SIMPLE EVERSION** (*Andrews's "Bottle" Operation*).—The tunica vaginalis is opened at its upper pole and the fluid evacuated. The testis is brought outside the scrotum and extruded through the opening in the sac, which is made only large enough to admit of the passage of the testis through it. The sac is then turned inside out and left without suture, or one or more sutures may be passed through the cut edges of the sac, securing it behind the cord to prevent reinversion. The testis and everted sac are now returned to the scrotum and the wound closed without drainage. In this operation the convalescence is short and there is little danger of hemorrhage, owing to the absence of much dissection. There is seldom any testicular pain and the everted sac

soon shrinks. The disadvantages of the operation are that it is not successful in old, thickened hydroceles, and that recurrence is not uncommon.

**EXCISION AND EVERSION** (*Winkelmann's Operation*) is the procedure accepted today as the best type. After dissecting free the parietal layer of the tunica the sac is trimmed off down to within one-half inch of its visceral insertion and the two cut edges of the parietal stump are sewed behind the testis by a continuous catgut suture. Great care must be taken to secure firmly all bleeding-points in the cut edges of the stump of the sac to prevent subsequent hemorrhage. The wound is closed with or without drainage, as may seem best in the individual case, and a snug support is applied over the dressing.

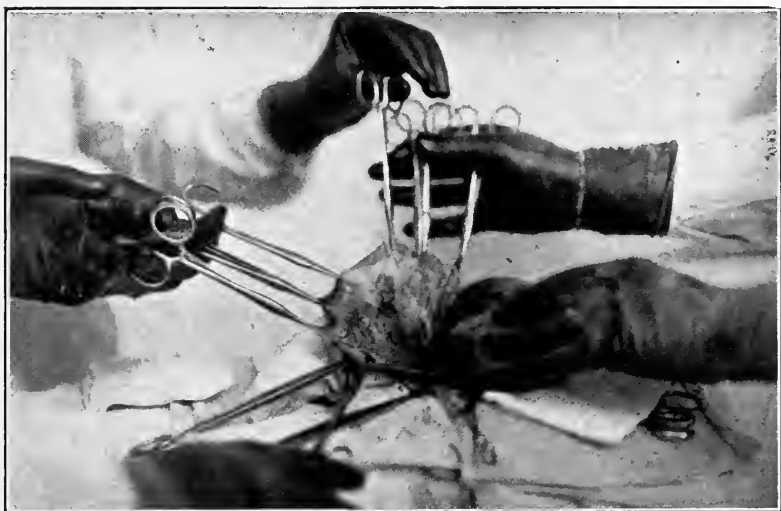


FIG. 211.—Hydrocele. The operator's hand rests on the unopened sac, which has been dissected free down to the cord.

Bartlett<sup>1</sup> has described a method of total extirpation of the unopened hydrocele. It involves a rather unnecessarily tedious dissection, and is suited only to a restricted class of cases. Vautrin<sup>28</sup> believes that in long-standing hydroceles with thickened walls, excision with eversion is not enough to prevent recurrence, and he makes a new bed for the testis in the connective tissue of the scrotum. This he finds an absolute safeguard against relapse. Volkmann's operation of wide incision of the sac, followed by swabbing its cavity with carbolic acid and allowing it to become obliterated by granulation, has been abandoned on account of the slow convalescence and the likelihood of recurrence due to localized failure of obliteration. Von Bergmann's operation of simple excision of the sac has also been generally replaced by one of the methods given above.

**Operative Complications.**—Operations for hydrocele may be followed by *hemorrhage*, *atrophy of the testis*, and *recurrence* of the disease.

*Hemorrhage* may take place as a result of the tearing of vessels during the separation of the sac wall or from the stump of the sac, and may develop some hours after operation, at which hemostasis was apparently complete. This can be guarded against at the time of operation by nice attention to separation of the sac along the proper line of cleavage, where one meets little bleeding, and by scrupulous care in tying off all bleeding-points. During the first twenty-four hours following operation all cases should be frequently inspected for evidence of bleeding. If hemorrhage occurs there is early complaint on the part of the patient of pain and a sensation of tension in the scrotum. When the loss of blood is slight it may be left to be absorbed; when large the treatment becomes that of hemocele.

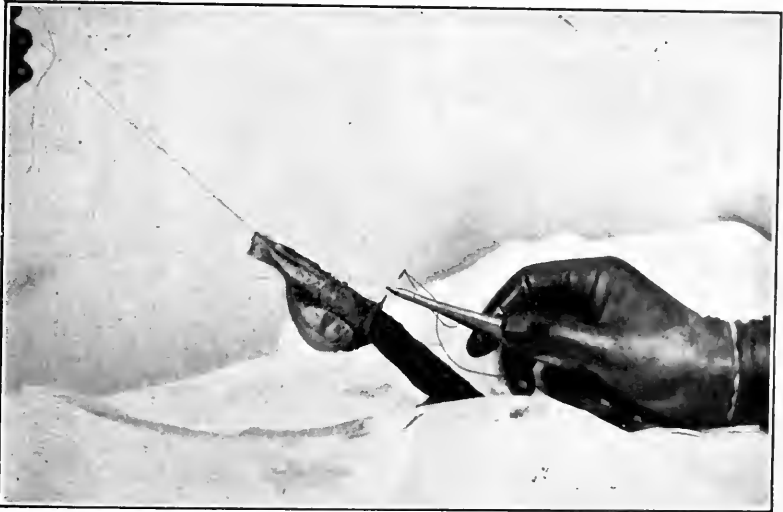


FIG. 212.—Hydrocele. The sac has been excised to within one-half inch of the testis. The last stitch is being taken in the everted edges, which are being sewed behind the cord.

*Atrophy of the Testis.*—Certain authors believe that the presence of the parietal layer of the tunica is necessary to integrity of the testis and that its removal in a radical cure for hydrocele interferes with testicular function. Others claim that the apparent atrophy of the testis which has been reported after operations on hydroceles is due either to a pressure atrophy from the long-continued presence of the hydrocele or to some unusual operative complication which has damaged the testis. Rolando<sup>4</sup> extirpated the tunica in dogs and later removed the testis at varying intervals following the primary operation. He reported that the testes removed early were smaller and softer than normal and showed thickening of the albuginea with no evidence of spermatogenesis. Those removed two or three months later showed spermatogenesis, but not in normal amount. At all events this complication is rare and cannot be considered a contra-indication to a radical cure of hydrocele.

*Recurrence.*—The liability to recurrence after radical operation will be considered under the heading of Results.

**Results of Various Types of Operation.**—Bruns<sup>4</sup> has collected statistics from a large number of operators, from which may be compared the merits of the two types of radical operation and the chances of subsequent recurrence.

*Aspiration and Injection.*—From reports of operators using either iodine or carbolic acid as an injection fluid he found 1593 cases with 95 known relapses, or 6.1 per cent. Of these cases a certain number had been followed up for a period varying from a few months to some years. There were 505 cases with 57 relapses, or 11 per cent., undoubtedly proving that the percentage of relapse for the entire series was too low. Of these 505 cases which had been later investigated, iodine had been used in 420 cases with 45 relapses, or 10.7 per cent; carbolic acid had been used in 85 cases with 12 relapses, or 14 per cent. Reports showed that carbolic acid was less painful and caused less local reaction, consequently a shorter convalescence. There were no reports of intoxication from carbolic acid, as has been the case with the use of iodin.

*Open Operations.*—Of all types of open operations results were secured from 1216 cases with 30 relapses, or 2.4 per cent. Of these there had been late investigation of 412 cases with 22 relapses, or 5.33 per cent. Thus the injection method for the whole series shows two and a half times the percentage of relapse that the whole series of open operations offers (6.1 per cent. as against 2.4 per cent.).

**Choice of Method of Treatment.**—*Tapping* has its place as a purely palliative measure in cases in which the patient's desire or condition makes it necessary, and it occasionally may result in a cure in children.

*Aspiration and injection* may be expected to produce a definite number of cures in a selected class of cases. It possesses the advantage of ambulatory treatment, short convalescence, and the avoidance of whatever slight danger attends any cutting operation. It is followed, however, by a much greater percentage of failures than the open operations.

*Open operations* involve hospital confinement and a longer convalescence. They are adapted, however, to all types of hydrocele and are followed by fewer recurrences. Since it is not alone the simplicity of the method to be chosen but the sureness of result that should guide the surgeon in his advice to patients, the open operation remains the most rational proceeding in that it gives the best guarantee of cure.

### Hydroceles due to Abnormalities of Development.

These forms of hydrocele are produced by interference with the obliteration of the peritoneal process in which the testis descends through the inguinal canal, and require separate mention. The particular type of abnormality associated with each of these forms has already been described under Varieties of Hydrocele.

**Congenital Hydrocele.**—This form of hydrocele occurs in infancy and is generally idiopathic. Rare symptomatic cases have been reported with congenital lues and accompanying orchitis. The idiopathic type is due to muscular straining in crying or too tight binders, causing pressure on the unclosed processus funicularis. Peiser<sup>23</sup> reports 73 cases, of which 26 were double, 33 on the right side and 14 on the left. In the prone position the fluid can usually be pressed back into the abdomen.

**Diagnosis.**—Congenital hydrocele and hernia frequently coexist. Both extend through the inguinal canal and both give an impulse on coughing. When either condition exists alone they may be differentiated by the fact that hernia is resonant on percussion and gives a gurgling, jerky reduction; it is not translucent and the testis can be identified. Hydrocele is dull to percussion, gives an even, slow reduction, is translucent, and until after reduction the testis is lost in the hydrocele. When both conditions are present, the signs may be confusing.

**Prognosis.**—Many cases are cured spontaneously during the first year. Complication with hernia somewhat decreases the probability of spontaneous cure.

**Treatment.**—Since hernia is a frequent complication some authors<sup>9</sup> prefer radical treatment between the third and sixth months to expectant treatment. If present the hernial sac may be treated at the same time. Injection treatment should never be used in this type.

**Infantile Hydrocele.**—This is more common than the congenital form; because the fluid does not communicate with the abdominal cavity the hydrocele is always irreducible. Hernia is a frequent complication. "Hydrocele en bissac" is a rare type of infantile hydrocele in which a portion of the hydrocele is in the scrotum and a portion in the abdomen.

**Treatment.**—Open operation, never injection, on account of the possibility of hernia coexisting.

**Inguinal Hydrocele.**—This is a rare form of hydrocele surrounding an undescended testis. The treatment of the testis governs the treatment of the hydrocele.

**Hydrocele of the Cord.**—Hydroceles of the cord are of two varieties, *diffuse* and *encysted*.

**Diffuse Type.**—The true diffuse form is a boggy infiltration of the connective tissue about the cord following the rupture of a hydrocele or spermatocele. Under the name of *multilocular hydrocele of the cord* are grouped echinococcus cysts, cysts of fetal remains and other rare types.

**Symptoms.**—The diffuse and multilocular types present a boggy tumor of irregular outline, which may extend from the scrotum to the inguinal canal or higher. The mass may be somewhat translucent, with slight impulse on coughing, and partial reducibility.

**Diagnosis.**—The tumor is to be diagnosed by its translucency and general irregular, boggy feel. In other respects it suggests an incarcerated omental hernia, and may occasionally be identified only after incision.

**Treatment.**—Often no treatment is advisable; incision has been used.

**Encysted Hydrocele of the Cord.**—This form represents a localized collection of fluid in the course of the cord. The fluid does not communicate with the tunica vaginalis below nor the peritoneum above. Cysts may be large or small, single or multiple. They occur more often in children than adults.

**Treatment.**—*Tapping* alone in children is often curative. *Aspiration* and *injection* with carbolic acid is useful in cases where the cyst is below the external ring. For cysts in the inguinal canal *excision* is indicated on account of the danger of hernia as a complication. Hematocele may follow injury to one of these hydroceles of the cord and demands the usual treatment of hematocele of the tunica vaginalis.

**Hydrocele of a Hernial Sac.**—A collection of fluid in the sac of a hernia after its contents have been reduced and after either spontaneous or artificial obliteration of the neck of the sac. It must be differentiated from a recurrent hernia.

**Treatment.**—Excision.

### HEMATOCELE.

An *hematocele* is formed when there is hemorrhage into the cavity of any form of hydrocele. Hemorrhage into the tissues is properly termed *hematoma*. As infiltrations of the scrotum and testis with blood often accompany the bleeding into the hydrocele sac, we frequently have the combination of hematocele and hematoma, to both of which, however, the former term is generally applied.

**Etiology.**—Hematocele may be *traumatic* or *spontaneous* in origin. If *traumatic* (1) it follows blows or crushing injuries of the scrotum and its contents, in which case the hemorrhage may infiltrate the scrotum as well as the hydrocele sac, or (2) it may be the result of hemorrhage subsequent to any operation upon a hydrocele or upon the epididymis or testis. *Spontaneous* hemorrhage into a hydrocele sac may occur in conditions of arteriosclerosis and scorbutus.

**Symptoms.**—*Traumatic* hematocele develops quickly with pain and tension in the scrotum and rapid increase of size of the hydrocele sac. Skin ecchymoses are frequently present. *Spontaneous* hematocele is of slow and insidious development, is almost never painful, and resembles the growth of a hydrocele. The contents of a recent hematocele are fresh blood, which later becomes brownish or chocolate-colored from admixture with fibrin and disintegration. The sac cavity may be entirely obliterated by fibrinous growths projecting from the sac wall and pressure on the testis in long-standing cases may cause its complete atrophy. Barrington<sup>1</sup> reports a case of spontaneous rupture in a hematocele of nine years' duration. Examination of the testis removed at operation showed that though it appeared normal macroscopically, there was entire degeneration of the tubules.

**Diagnosis.**—With a definite history of recent injury to or operation on the scrotal contents, the diagnosis of hematocele is easy and is made

by the same signs as those presented by acute hydrocele minus the translucency and with the usual added presence of ecchymoses. The real difficulty in diagnosis is to differentiate the slowly developing painless hematocele caused by spontaneous hemorrhage into the tunica vaginalis from a neoplasm of the testis. Woollfenden<sup>3</sup> reports a supposed case of hematocele, which was assigned to students by examiners for the degree of M.B., which at later operation proved to be a sarcoma of the testis.

**Treatment.**—Ordinary traumatic hematocele requires the same treatment as acute hydrocele—rest, elevation, and hot, moist dressings. Many authors recommend the application of ice and cooling lotions, but they are not as grateful to patients, in our experience at least, as some form of heat. Extensive hemorrhage with danger of atrophy of the testis from pressure or suppuration demands incision and drainage. With the more slowly developing type of hematocele due to spontaneous hemorrhage, unless the history is perfectly clear, it is far safer to operate to prove or exclude the presence of a malignant growth of the testis. Orchidectomy is indicated in long-standing hematocele.

### CHYLOCELE (GALACTOCELE).

This is a rare condition in which chyle is present in the tunica vaginalis. It is usually seen in the tropics and is due to the presence of the *Filaria sanguinis hominis* in the lymphatics of the cord, causing engorgement and leakage of the chyle into the tunica vaginalis. It resembles hydrocele except that its contents are milky and the patient presents the symptoms of filariasis.

**Treatment.**—The treatment consists in *excision*, with an attempt to remove the affected lymphatics.

### SPERMATOCELE.

**Etiology.**—Spermatoceles are true retention cysts in or about the epididymis or rarely of the testis and are produced by any process which blocks the outlet of seminiferous tubules, leading to distention of the tubule by semen, which continues to be secreted, and cyst formation. The present view discredits the theory of the origin of spermatocele in fetal remains.

With relation to the tunica vaginalis these cysts may be *extravaginal* or *intravaginal*. The *extravaginal* type is the more common and usually arises behind the testis and between it and the epididymis, and develops in a direction in which there is no covering of tunica vaginalis. The *intravaginal* type develops from some portion of the epididymis, which is covered with tunica vaginalis, and pushes it ahead of it in its growth. These cysts may attain large size and entirely fill the cavity of the tunica vaginalis. Their rupture into the cavity is held to be a cause of hydro-

cele as well as to account for the presence of spermatozoa found in some hydroceles. Spermatocele occurs mostly between the ages of twenty and forty; there are few cases in old men. It is more frequent on the right than on the left side and may be bilateral; it may accompany hydrocele.

**Pathology.**—Spermatoceles conform to the type of true retention cysts in that they arise from a preformed cavity, they are lined with its epithelium, and their contents correspond to that of the affected organ. Injection preparations have been made from spermatoceles showing direct connection with seminiferous tubules. The larger cysts which usually occur in young adult life are attributed to obstructive processes in the vasa efferentia, and the smaller cysts of later life, to senile cystic enlargement of the tubules.

**Fluid.**—The fluid of spermatocele is milky and filled with seminal elements. Its amount rarely exceeds three or four ounces, although cases have been reported in which over fifty ounces were withdrawn. As distinguished from hydrocele fluid it is cloudy, neutral, of light specific gravity (1009), and contains less solids and albumin. The spermatozoa may be motile or dead. The former occurs if a connection exists between the cyst and seminiferous tubules, through which fresh semen is constantly supplied. If the spermatozoa are dead it is supposed that the connection with vasa efferentia has been lost.

**Symptoms.**—The cysts of young adult life present the signs of a slowly growing painless enlargement at the top of the testis. Pain at the end of intercourse has been reported in a few cases of the intravaginal type. The tumor is usually heart-shaped and may grow to large size, producing a sense of dragging on the cord. It is not translucent, may be fluctuant, and is elastic and tense. The position of the testis depends upon the direction of growth of the spermatocele, and may be pushed forward, downward, or backward.

**Diagnosis.**—The demonstration of a heart-shaped tumor above and behind the testis and the recovery of the typical fluid by aspiration are the chief means of diagnosis. The shape of the tumor, however, is not constant nor its position with relation to the testis. The testis and epididymis can be more clearly palpated than in hydrocele, when they are surrounded by it. If the spermatocele is complicated by hydrocele, or if it is of the intravaginal type, the diagnosis will only be made by aspiration. Hydrocele of the cord cannot at times be differentiated from spermatocele. The former occurs chiefly in childhood, however, is distinctly separable from the testis and epididymis and fixed as a part of the vas.

**Treatment.**—Small cysts require no treatment. Aspiration and injection are usually ineffectual and not to be advised. Larger cysts should be excised. After incising the skin over the cyst it is opened, its contents evacuated, and the cyst wall shelled out. Often a well-defined pedicle is found which should be tied off. The wound is closed with or without drainage as seems best.

## VARICOCELE.

Varicocele is a condition in which there is dilatation, elongation, and tortuosity of the veins of the spermatic cord. It is generally limited to the spermatic vein, although occasionally the cremasteric and deferential veins may also be affected.

**Anatomy.**—The spermatic vein originates at the posterior border of the testis as a thick network of eight to ten vessels called the pampiniform plexus, most of which lies anterior to the cord. These veins pass upward through the inguinal canal and unite into one trunk in the abdominal cavity. The vein of the right side passes into the vena cava, the left vein into the left renal vein.

**Symptomatic Varicocele.**—*Varicocele may be symptomatic or idiopathic.* The *symptomatic* type is the result of obstruction to the spermatic vein by some abdominal tumor. It is rare, occurs late in life, develops rapidly, and is associated with malignant growths, especially of the left kidney, though it may be produced on either side. White<sup>14</sup> reports a case of acute left varicocele of six weeks' duration which immediately disappeared on the removal of a pyonephrotic left kidney.

**Diagnosis.**—The age of occurrence, its rapid and painless development, and the fact that when the patient lies down the veins do not empty themselves as in ordinary varicocele are the principal points of diagnosis.

**Treatment.**—The varicocele disappears with the removal of its cause.

**Idiopathic Varicocele.**—**Etiology.**—This type is a common condition in young men between the ages of fifteen and thirty-five. In a study of 403 cases Barney<sup>1</sup> found 81 per cent. occurred between those ages, and were unmarried. Youth and celibacy seem to be suggestive factors. The classical location is the left side (over 90 per cent.), the right side is rarely affected alone, and both sides more rarely. Of 3911 cases, Curling<sup>1</sup> found 3360 on the left, 282 on the right, and 269 bilateral. Sistach,<sup>1</sup> in 7611 cases, found 308 on the right and 305 bilateral.

Many causes have been adduced to account for varicocele. To say that the spermatic veins are long and tortuous, with a vertical course, and receive little or no support from the loose surrounding tissues, offers a seemingly reasonable explanation, but these factors are present in every male, and all men do not have varicocele. To account for the preponderance of left-sided varicoceles are the anatomical facts; that the left testis hangs lower than the right, the left spermatic vein is consequently longer; it has no valves, and empties at right angles into the left renal vein, where it is less advantageously drained than on the right side, where the vein enters the vena cava at an acute angle and a lower level. These facts are undoubtedly of importance, but they still do not explain the occurrence of varicocele in the young and its comparative absence in the old, in whom conditions would be supposedly ideal for its development. The most probable explanation is that varicocele is a functional disorder, due to a local chronic passive congestion induced by unrelieved sexual stimulation or by overindulgence. This hypothe-

sis would account for the frequent disappearance of varicocele under the normal sex relations of married life and its absence in old men whose sexual powers are in abeyance. A congenital diathesis to varices, constipation and trauma, claimed as contributing factors, probably have no relation to the production of varicocele.

**Pathology.**—The veins may be merely tortuous and dilated, or the process may go on to the stage of complete break-down of the valves with fatty atrophy, areas of thickening, and phlebolith formation.

**Symptoms.**—Varicocele may produce no *subjective* symptoms even though of considerable size. Conversely a small developing varicocele may be the cause of a great deal of dragging *pain* along the course of the cord and in the testis. This is probably analogous to the pain in the leg at the time of development of a varix.

*Mental symptoms* varying from mild sexual neurasthenia to melancholia are often associated with this as with other genital diseases. The quack and the charlatan have found in varicocele a gold mine.

The *objective* symptoms are the low-hanging testis, the relaxed scrotum, and the mass of enlarged tortuous veins. The scrotal veins may at times be affected also. When the patient lies down the veins empty themselves and the varicocele disappears. Atrophy of the testis follows a long interference with its circulation, but is comparatively uncommon (11 per cent.).<sup>1</sup> Many cases of restoration of the testis to normal size and consistency after operation have been reported, and certain authors believe that the apparent atrophy was merely under-development.

**Diagnosis.**—The peculiar feel of the enlarged veins in varicocele is so characteristic that it is not likely to be confounded with any condition except an omental hernia. This may be differentiated as follows: If after the veins are emptied by having the patient lie down the finger is held over the external ring and the patient rises, the varicocele, if one is present, refills, while an omental hernia is held back by the finger. The complicating presence of a hydrocele or hernia may make the diagnosis more difficult.

**Treatment.**—Many varicoceles require no treatment, as they produce no discomfort. The local symptoms produced by many others may be entirely relieved by the use of a snug suspensory. The patient should be strongly assured that his disease is not serious and that it will not lead to impotency or any other of the dire results of which these sufferers are apprehensive. Mental symptoms should be met by a rational psychotherapy, with sex hygiene and marriage offered as a solution of the trouble.

*Indications for Operation.*—For the cases in which for various causes the foregoing measures do not suffice, operative treatment is indicated. In Barney's<sup>1</sup> series of 403 cases the patients came to operation for the following reasons: unrelieved and persistent pain, 270; no special reason given, 68; inconvenience, 22; mental symptoms, 18; qualifications for civil, army, or navy service, 17; recurrence following previous operations elsewhere, 8.

In the German army<sup>15</sup> a suspensory is first tried with officers and men complaining of symptoms from their varicoceles. If they are not relieved by this treatment operation is done.

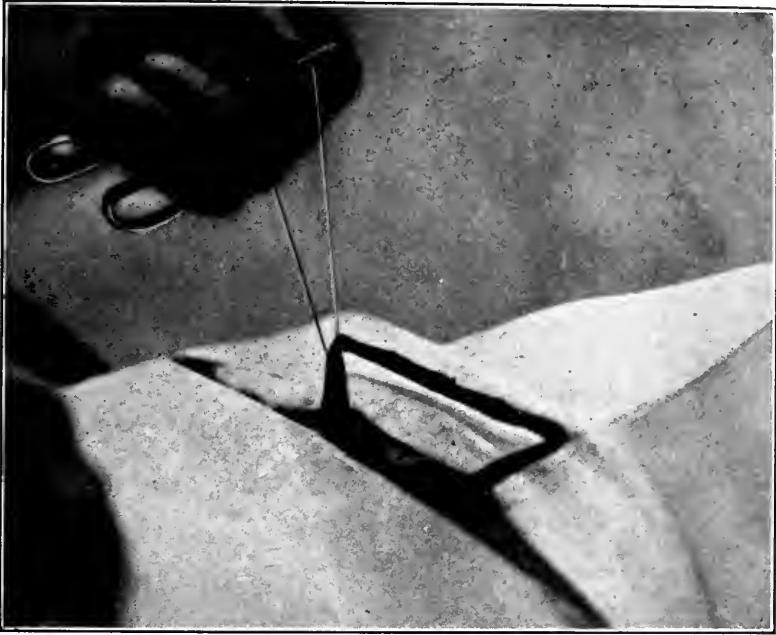


FIG. 213.—Varicocele. The veins have been separated from the cord, and ligated above and below.



FIG. 214.—Varicocele. A section of the veins has been excised, and the two stumps are being tied together.

Operation is indicated then in varicoceles for *persistent pain* unrelieved by a suspensory; for *uncomfortable size*; in cases in which *atrophy of the testis is feared*; and in the presence of marked *neurotic symptoms*. The operation in itself, however, will not cure sexual neuroses, and we have seen patients who were so disappointed at lack of immediate results that their last state was worse than the first. A course of psychotherapy following the operation is important with neurotic patients, and no operation should ever be done on them without the existence of a definite pathological condition in the veins. Other indications for operation are the absence or disease of the other testis, the complication of hernia or hydrocele of the same side, a history of a recurrent phlebitis, thrombosis, spontaneous rupture, or calcareous condition of the veins.

*Types of Operation.*—Varicocele may be treated by *subcutaneous ligature* or by *open operation*, involving excision of a portion of the veins with elevation and support of the testis.

*Subcutaneous ligation* of the veins of a varicocele is a blind and unsurgical procedure. It presents the danger of hemorrhage from the wounding of a vein with a needle and the possibility of recurrence from the failure of the ligature to obliterate the vein. It offers, further, no support for the testis. The method should be abandoned in view of the simplicity and efficiency of the following operation.

*Open Operation.—Technic.*—Local or general anesthesia may be used, preferably the latter if the patient is neurotic. A high incision two inches long is made above the inguinal canal with its lower end over the external ring. The dissection is carried down to the cord with its overlying veins and the fascia enclosing it opened. At this level the veins have united into three or four trunks, and may easily be separated from the vas and its vessels. By pulling up the testis into the incision the separation may be carried down to within one inch of it. The separated mass of veins is ligated above and below and a sufficient section is excised so that by approximating the two stumps the testis will be elevated to a proper position opposite its mate. Great care should be taken to secure firmly all the cut veins by individual ligatures if necessary. The distal stump of veins is then brought up to the proximal stump and tied to it, which serves as a support for the testis. Fascia and skin are closed without drainage and a suspensory dressing applied. Patients should be kept in bed about a week.

Ablation of the scrotum with the idea of providing a support for the testis is a useless procedure, as the scrotal skin which remains is capable of further stretching. It is also unnecessary for the purpose of removing redundant tissue, as this will slowly contract when the weight of the testis is removed by elevation.

**Complications.**—Atrophy of the testis and traumatic hydrocele are rare sequels to operative treatment. The hydrocele if it occurs may be left to absorb or may require tapping.

**Results.**—In the series quoted above a certain number of the cases were investigated at periods of from one to ten years after operation.

Of these, 36 per cent. still complained of some pain in the groin or testis; 27 per cent. had some form of sexual neurosis; and 15 per cent. had recurrences. On the other hand, there was no case of atrophy of the testis; in 30 per cent. the testis had grown larger since operation, and 80 per cent. acknowledged they had been distinctly benefited.

## BIBLIOGRAPHY.

## HYDROCELE.

1. Bartlett: Extirpation of the Unopened Hydrocele, *Jour. Am. Med. Assn.*, 1909, liii, 2149.
2. Bennett: A Case of Traumatic Hydrocele and Injury to the Perineum, *Clin. Jour.*, London, 1910, xxxvii, 289.
3. Blakeway: Encysted Hydrocele of the Epididymis, *St. Bartholomew's Hosp. Rep.*, 1911, xlv, 192.
4. Bruns: Die Behandlung der Hydrocele (Inaugural Dissertation), Berlin, 1912.
5. Caforio: Sulla patogenesi dell' idrocele essenziale contributo alla diagnosi differenziale fra essudati e transudati, *Gazz. internaz. di med.*, 1912, xv, 1089.
6. Caforio: Ricerche ulteriori sull'autosieroterapia dell' idrocele, e sul meccanismo di azione degli autosieri, *Riforma med.*, 1912, xxviii, 982 and 1014.
7. Cummins: Hydrocele en Bissac, *Jour. Roy. Army Med. Corps*, 1912, xviii, 76.
8. D'Alberto: Nuovo processo di cura radicale dell' idrocele, *Gazz. d. osp.*, Milano, 1910, xxxi, 561-562.
9. Dunn: The Association of a Patent Funicular Process with Certain Forms of Hydrocele, *Brit. Med. Jour.*, 1909, ii, 758.
10. Fiori: Dell' autosieroterapia in generale con speciale riguardo ai risultati dell' autosieroterapia dell' idrocele, *Riv. ospedal.*, Roma, 1912, ii, 1-8; also *Med. ital. Napoli*, 1912, x, 1-8.
11. Formiggini: Contributo allo studio delle cisti del funicolo spermatico di origine connettivale, *Riforma med.*, Napoli, 1913, xxix, 1269 and 1300.
12. Fracassini: Sopra una varietà non comune d'idrocele, *Policlin.*, Roma, 1910, xvii, 1518-1521.
13. Hastings: On Rupture of the Tunica Vaginalis in Hydrocele, *Lancet*, 1910, i, 916-919.
14. Lockwood: Hydrocele of the Cord, *Urol. and Cutan. Rev.*, 1914, xviii, 534.
15. Keyes: Diseases of the Genito-urinary Organs.
16. Mallanah: A Vaccine Treatment of Hydrocele, *Brit. Med. Jour.*, 1912, i, 184.
17. Marcozzi: Une nouvelle methode de traitement de l'hydrocele avec le fil de magnesium, *Ann. des mal. des organ. Genit. Urinaires*, 1909, i, 739.
18. Morestin: Hydrocele rompue, *Bull. et mém. Soc. de chir.*, 1912, xxxviii, 542-544.
19. Morestin: Hydrocele vaginale traitée par la ponction formolée, *Bull. et mém. Soc. de chir.*, 1912, xxxviii, 1460; *ibid.*, 1913, xxxix, 791.
20. Moschowitz: Hydrocele of the Tunica Vaginalis; Two Recurrences after the Winckelmann Operation, *Ann. Surg.*, 1913, lviii, 561.
21. Müller: Ein Beitrag zur operation der hydrokele, *Zentralb. f. Chir.*, 1913, xl, 1140.
22. Nicoll: Six Cases of Hydrocele in Infants Treated by Operation, *Brit. Med. Jour.*, 1913, i, 384.
23. Peiser: Ueber Phimose und Hydrokele in Säuglingsalter, *Berlin. klin. Wehnschr.*, 1912, xlix, 1084-1086.
24. Posner: Zur Pathologie und Therapie der Hydrokele, *Berlin. klin. Wehnschr.*, 1911, xlviii, 390.
25. Ransohoff: Venous Thrombosis and Hydrocele of the Inguinal Canal, *Ann. Surg.*, 1908, xlviii, 247.
26. Squier: An Unusual Type of Hydrocele, *Jour. Am. Med. Assn.*, 1913, lx, 1226.
27. Tait: Recurrence of Hydrocele after Radical Treatment, *California State Med. Jour.*, 1913, xi, 258.
28. Vautrin: La cure opératoire de l'hydrocele vaginale, *Arch. gén. de chir.*, 1913, ix, 897-913.
29. Vecchi: Allo studio del liquid d'idrocele, *Gazz. med. ital.*, Torino, 1912, lxiii, 211 and 221.
30. Whitney: Hydrocele and its Radical Cure by the Insertion of Catgut, *Boston Med. and Surg. Jour.*, 1911, clxv, 204-211.

31. Wilkinson: The Radical Operation for Hydrocele, *Am. Jour. Dermat. and Genito-urinary Dis.*, 1911, xv, 376.

32. Zaffiro: Contributo all studio dell' idrocele multiloculare e delle cisti connettivale, *Gior. di med. mil.*, Roma, 1913, lxi, 108-119.

33. Zdanowicz: Zur Frage über die Anwendung der Autoserotherapie bei Hydrocele, *Ztschr. f. Urol.*, 1913, vii, 386.

#### HEMATOCELE.

1. Barrington: Spontaneous Rupture of a Hematocele of the Tunica Vaginalis, *Brit. Jour. Surg.*, ii, No. 7, p. 398.

2. Harrison: Hematocele Studied with Reference to Etiology, Pathogenesis, and Therapeutics, *Virginia Med. Semimonthly*, 1911-12, xvi, 53.

3. Woolfenden: On the Similarity between the Signs of Hematocele and Early Malignant Disease of the Testis, *Med. Press and Circ.*, 1911, xcii, 198.

#### SPERMATOCELE.

1. Ebert: Ueber Spermatocoele (Inaugural Dissertation), Leipzig, 1912.

2. Hanusa: Ueber Spermatocoele, *Beitr. z. klin. Chir.*, 1910, lxi, 255.

3. Posner: Remarks on Spermatocoele, *Am. Jour. Urol.*, 1908, iv, 237.

4. Whitney: The Etiology and Diagnosis of Spermatocoele, with a Report of Three Cases, *Am. Jour. Urol.*, 1907, iii, 175.

#### VARICOCELE.

1. Barney: Varicocele: An Analysis of Four Hundred and Three Cases, *Pub. Mass. Gen. Hosp.*, 1910, iii, 335.

2. Blech: Varicocele: its Pathology with Reference to the Soldier and a New Operation for its Relief, *Mil. Surg.*, 1910, xxvi, 5-39.

3. Corner: Ligation of the Spermatic Artery in the Operation for Varicocele, *Lancet*, 1911, ii, 1094.

4. Frank: Eine neue Methode zur Operation der Varikokele, *Zentralb. f. Chir.*, 1914, xli, 588-590.

5. Heineck: The Modern Operative Treatment of Varicocele of the Spermatic Cord, *Illinois Med. Jour.*, 1910, xviii, 551-569.

6. Istomin: Zur pathologischen Histologie und Klinik der Varikokele, *Deutsch. Ztschr. f. Chir.*, 1909, xcix, 1-46.

7. Istomin: Zur Frage der operativen Behandlung der Varikokele, *Zentralb. f. Chir.*, 1914, xli, 93-95.

8. Lameris: Zur Behandlung der Varikokele, *München. med. Wchnschr.*, 1910, lvii, 674-677.

9. Madden: Lymphatic Varicocele, *Lancet*, 1912, i, 17.

10. Mariani: Blasenncuralgie infolge von Varikokele, *Ztschr. f. Urol.*, 1911, v, 656.

11. Schwarz: Der Einfluss der Leiste auf die Varicocele, *Beitr. z. klin. Chir.*, 1910, lxi, 547-568.

12. Van Hook: Varicocele Operations, *Surg., Gynec. and Obst.*, 1914, xviii, 759.

13. Volpe: Nuovo metodo di cura chirurgica del Varicocele, *Policlin.*, Roma, 1910, xvii, sez. prat., 227.

14. White: *Brit. Med. Jour.*, 1914, ii, 177.

15. Wolf: Erfahrungen mit der von Nilson angegebenen Modifikation der Narathschen Varikozelenoperationen, *Deutsche med. Wchnschr.*, 1912, xxxviii, 1929-1932.

16. Zironi: Contributo clinico al trattamento operativo del Varicocele, *Clin. Chir.*, Milano, 1911, xix, 1215-1241.

(See modern text-books.)

## CHAPTER XV.

### INFECTIONS OF THE TESTICLE.

By J. DELLINGER BARNEY, M.D.

ACUTE infections of the testicle as compared with those of the epididymis are relatively infrequent, for, as Smith<sup>32</sup> well says: "It is only in recent years that differentiation has been made between processes affecting the epididymis and those affecting the testicle. Even today we frequently hear of 'gonorrheal orchitis' when epididymitis is the real disease."

But it must be borne in mind that infection of the testicle proper, although uncommon as compared with that of the epididymis, arises not infrequently as a complication of certain of the infectious diseases. These diseases are typhoid fever, syphilis, smallpox, and mumps; rarely tonsillitis, glanders, dengue, acute articular rheumatism, malaria, gout, scarlet fever, influenza, and typhus fever. In the presence of a septic process anywhere in the body (osteomyelitis) abscess of the testicle may occasionally arise, while a few cases have been reported of infection by the colon bacillus, the *Bacillus mucosus capsulatus*, and the *Staphylococcus aureus* and *albus* whose source could not be determined.

**Etiology.**—An inquiry into the frequency with which the testicle is attacked in the various infections already enumerated shows that in proportion to the number of cases of the disease these testicular infections are rare.

Pike,<sup>26</sup> in 1911, collected from the literature 102 cases of orchitis of typhoid origin. McCrae<sup>24</sup> found only 4 in a series of 1500 cases (0.27 per cent.), while in a total of 5500 cases of typhoid fever, the combined statistics of Osler,<sup>25</sup> Liebermeister,<sup>23</sup> Sorel,<sup>33</sup> and Hölscher,<sup>14</sup> the testicle was involved but 14 times (0.25 per cent.). On the other hand, Pierre Do<sup>18</sup> found no instance of epididymo-orchitis among 14,738 cases of typhoid fever collected from French and German sources.

The severity of the typhoid fever has no relation to the incidence of orchitis. It usually arises early in the course of convalescence, may attack a patient of any age (usually the young adult), and in most cases involves both testicle and epididymis. Beardsley,<sup>3</sup> in 102 cases, found both sides involved in 3; when unilateral, the right side was affected more often than the left. Suppuration occurred in 22 of the 102 cases. In 13 suppurating testicles reported by Kinncutt<sup>19</sup> a pure culture of the typhoid bacillus was grown from the pus. Symptomatic hydrocele is not infrequent.

Syphilis of the testicle (gumma) is said to be uncommon and will probably become more so owing to improved methods of treating the disease. Keyes,<sup>17</sup> in 2170, syphilitics found the testicle involved only 67 times, of which but 10 were bilateral. While I have no definite statistics of these cases, I believe them to be more numerous than this. The testicle alone is affected in a small majority, in others the epididymis shares the infection. Suppuration of the gummatous testicle is rare, but necrosis may occur from endarteritis.

Acute orchitis as a complication of smallpox (variola) and due to secondary pyogenic infection has long been recognized, but its incidence as given by different writers seems to vary widely. It seems to occur both before and after puberty. Thus, Roger<sup>30</sup> found 48 infected testicles out of 55 in patients dying from smallpox, while Quénu<sup>29</sup> says that in severe forms of the disease the testicle is left intact only once in ten times. On the other hand, Hare and Beardsley<sup>13</sup> observe that "orchitis, single or double, and usually accompanied by an effusion of fluid into the tunica vaginalis, is a rare complication of variola." Welch and Schamberg<sup>37</sup> observed this complication but 8 times in 2000 cases of variola. It is probable that the virulence of the epidemic, the method of treatment, and the fact of vaccination are factors which would influence the incidence of this complication.

The orchitis of epidemic parotitis (mumps) is of frequent occurrence in the adult, and may occasionally occur before puberty. The well-known study of Laveran and Catrin<sup>21</sup> shows that it is likely to occur once in every 3 cases of mumps. In 43 cases it was bilateral in 13, on the right side in 18, and on the left side in 12. Osler<sup>25</sup> records 211 instances in 699 cases of mumps. The frequency of orchitis in a disease which is so common and otherwise so comparatively mild, the large proportion of bilateral cases, and the almost certain destruction of the spermatogenetic function of the organ warrants serious consideration. Acute orchitis is mentioned in the text-books as an occasional complication of glanders, influenza, dengue, acute articular rheumatism, malaria, scarlet fever, and typhus fever. I have, however, seen no record of a definite case.

Such a complication in tonsillitis was long ago recognized by Verneuil<sup>35</sup> and later carefully discussed by Lasègue.<sup>20</sup> Joal,<sup>16</sup> in 1886, reported 4 cases and went with great thoroughness into the relationship between tonsillitis and epididymo-orchitis. Occasional instances of this rare complication of tonsillitis have been reported from time to time, the most recent being that of Prouty.<sup>23</sup>

Septic foci, such as furunculosis and osteomyelitis may occasionally give rise to an acute epididymo-orchitis, a case of the former being reported by Quénu,<sup>29</sup> while Biland<sup>5</sup> records a similar complication in osteomyelitis of the acromion process. The rarity of an orchitis from this source may be judged from the fact that I have found no other cases of it in the literature.

Finally, there are on record a very few cases of what may be called "idiopathic" orchitis with infection by a pyogenic organism in the

absence of any demonstrable focus. Du Bois<sup>8</sup> reports such a case of staphylococcus infection, and LeFur<sup>22</sup> tells us of another. I<sup>1</sup> have already reported 3 such cases and more recently have operated upon a fourth. My colleague, Smith, has also met with one within the year, at the Massachusetts General Hospital. In 2 of my own cases the colon bacillus was found in pure culture. In another the *Bacillus mucosus capsulatus* was the offender, with a few streptococci sprinkled in. Cultures from the other cases were unsatisfactory.

It is therefore clear that almost any organism in the blood stream may enter the testicle and may, under favorable conditions for growth, produce its characteristic lesions.

**Pathology and Pathogenesis.**—It is well known that the animal organism combats bacilluria by elimination of the bacteria in the circulating blood through the glands, chiefly kidneys, but we also know that the salivary glands (Quénu<sup>29</sup>), the seminal vesicles (Huet<sup>15</sup>), and other organs may share in this work. That the human testicle may also assume this excretory function has been shown by Belfield<sup>4</sup> who says: "While the kidney is provided with a new and private sewer, the ureter, the testis continues to use the frog's old urinary duct, now called epididymis and vas deferens. This excretory function of the testicle and its duct illumines both its intimate alliance with the kidney and its frequent infection from the blood. The recognition of the testicle as an excretory organ illumines the frequent invasion of its tubules by mumps, typhoid and colon bacilli, *Spirochaeta pallida* and other blood infections." Be it further noted that the testicle and other organs may assume this excretory role without damage to their epithelium (von Biede and Kraus<sup>36</sup>), and when pathological changes occur, they must be regarded as an index either of an unusual virulence of the organisms, or of a lowered resistance on the part of the gland.

While we have already seen that the testicular tissue is favorable for the growth of the typhoid bacillus, the *Spirochaeta pallida*, and pyogenic bacteria, as well as for certain other, as yet unknown, organisms (*e. g.*, that of mumps), it is common knowledge that the gonococcus rarely, if ever, finds lodgment in this organ, and the tubercle bacillus (with very rare exceptions) only after a primary invasion of the epididymis. For an explanation of this phenomenon we must ascribe to the testicle not only an excretory, but also a selective function. It is well established that organisms of various types may and do circulate in the blood stream at various times. It is clear that these organisms must find their way into the testis and epididymis as freely and as frequently as into other organs; perhaps more so, owing to their common blood supply, the spermatic arteries, which take origin from the aorta. This has been demonstrated by Piqué and Worms<sup>27</sup> in a large series of careful dissections of injected human specimens (Figs. 215, 216 and 217). They have shown constant but slightly variable anastomoses between the spermatic, the deferential, and the funicular arteries (the latter running in the walls of the tunica vaginalis). It is thus seen that bacteria reach the testicle and epididymis with equal facility. While the comparative



FIG. 215. — Type I. 1, spermatic artery; 2, epididymal branch of the spermatic; 3, deferential artery; 4, funicular artery; 5, epididymo-funiculo-deferential anastomosis in form of T. (From Picqué and Worms, loc. cit.)

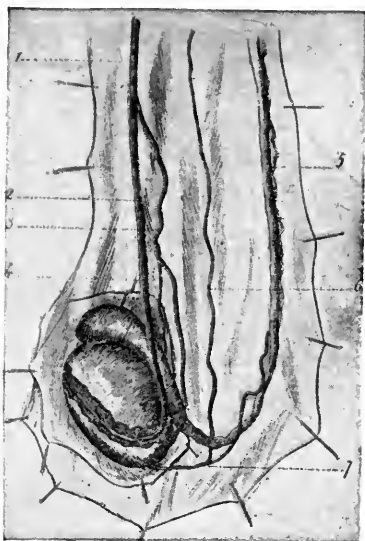


FIG. 216. — Type II. 1, spermatic artery (main trunk); 2, internal spermatic artery; 3, external spermatic artery; 4, epididymal branch; 5, deferential artery; 7, spermato-funiculo-deferential anastomosis in form of T.



FIG. 217. — Type III. 1, spermatic artery; 2, epididymal branch of spermatic artery; 3, deferential artery; 4, funicular artery; 5, anastomosis between epididymal branch and deferential artery; 6, anastomosis between a testicular branch of spermatic and funicular artery.

infrequency of orchitis as compared with epididymitis is undoubtedly due very largely to the fact that the testicle, as Belfield<sup>4</sup> has shown, excretes the bacteria which enter it into the epididymis, there are two other factors which undoubtedly contribute to its comparative immunity from infection. These are:

First, the tunica albuginea whose protective value was long ago recognized by Grendin.<sup>12</sup> He says: "When the contiguous organ or adjacent part is of a different structure from that of the cellular tissue, the extension of the inflammation inward is checked. Thus in the case of the inflamed tunica vaginalis the cellular tissue readily transmits the morbid action to the epididymis, but the tunica albuginea arrests its progress to the body of the testicle."

Second, Testut<sup>34</sup> and others have pointed out that the testicle is surrounded and permeated by a very rich lymphatic network, much greater than that enjoyed by the epididymis.

Furthermore, the elaborate blood supply, already mentioned, while serving as a path along which bacteria can travel, undoubtedly serves at the same time as a highly efficient means of defense.

In most testicular infections it is obvious that the organisms travel by way of the blood stream. This would hold true in general systemic diseases such as typhoid fever, or in pyogenic septicemia (from furunculosis or osteomyelitis, for example). In certain other cases the vas deferens or the lymphatics of the spermatic cord must be held accountable for the transmission of organisms.

This hypothesis would apply particularly to the cases with preëxisting inflammation of the organs at the bladder neck or of the urethra, as in a case recorded by Dalous<sup>7</sup> and in two of my own cases. The researches of many, especially Baumgarten,<sup>2</sup> have shown that infections travel usually with the stream of the secretion of the organ involved. While there are exceptions to this rule, with reversal of peristalsis in the vas deferens, it is evident that it furnishes, in most cases, ample ground for the elimination of this structure as a path along which organisms can travel.

There is left, then, the possibility of a lymphangitis or of a phlebitis. While a retrograde lymphangitis is certainly an uncommon phenomenon, Dalous<sup>7</sup> and Quénu<sup>29</sup> are in agreement that it can occur, especially in the spermatic cord and testicle, and they further observe that it may take place without the usual clinical manifestations of its presence. Whether a phlebitis, transmitting its infection to the testicle, can be held accountable for these infections is open to argument. There appears to be no definite proof that it occurs. The fact remains that in gonorrheal epididymitis it is not unusual to observe pain, tenderness, and induration of the spermatic cord slowly progressing from groin to epididymis, and Kinnicutt<sup>18</sup> describes a similar order of events in a case of typhoidal epididymo-orchitis.

On the other hand, there are several examples of transmission of the infection from testicle to bladder and urethra, probably through the vas deferens. Thus in one of my cases the urine at first was clear and

sterile to culture. Several days after orchidectomy there appeared a urethral discharge together with cloudy urine. Cultures showed the same organism as was found in the testicular abscess. This experience coincides with that of other observers. These data furnish additional proof of the excretory function of the testicle, which, by eliminating organisms through epididymis and vas deferens, infected the urethra and bladder neck.

**Pathology.**—The pathology of testicular infections has been comparatively little studied. Smith<sup>31</sup> in a recent article describes a case of epididymo-orchitis of typhoid fever operated upon by Cabot. The former says: "There was a small amount of free fluid within the tunica and a gelatinous exudate covered the testicle. The epididymis was enlarged to four or five times its normal girth, was tense and hard, and in color a reddish purple. The testicle was of normal size, and in its upper two-thirds of normal color. The lowest third, which was separated from the upper portion by a sharp line of demarcation, was slightly swollen and of a darker color. A nick was made through the tunica albuginea of this part of the testicle; the underlying tissue was dry and did not bleed. No pus was obtained (from the epididymis) but the serous fluid which oozed from the punctures showed a pure culture of the typhoid bacillus. The involvement of the testicle was caused by the occlusion of its arterial supply (the capsular artery, a branch of the spermatic, which pierces the tunica albuginea close to the epididymis)."

There seems to be no good description of such infections of the testicle which have suppurated, but Girode<sup>10</sup> has shown that the suppuration is between, not within, the canaliculi.

The pathology of syphilitic infection of the testicle and epididymis is that of gumma, plus the changes wrought by interstitial sclerosis in the seminiferous tubules. These are destroyed to a greater or less extent by the sclerotic changes, but after an arrest of the syphilitic process show a marked recuperative power.

For the pathology of the orchitis of mumps we are again indebted to Smith,<sup>31</sup> who recently operated upon two such testicles. The tunica vaginalis was opened "with escape of about one ounce of turbid yellow fluid. The testicle was three times the size of a normal testicle, firm and elastic on palpation. The color was more bluish than is usual, and throughout the tunica albuginea were scattered many minute reddish specks, probably punctate hemorrhages. The epididymis was definitely enlarged, soft, without induration, and of a deep red color which at the globus major became almost black. The cord was somewhat edematous, the vas normal." A second case presented "an almost identical picture." Small sections of these testicles were examined by Dr. S. B. Wolbach, associate professor of bacteriology in the Harvard Medical School. He says: "The process does not affect the testicle tissue uniformly. There are groups of seminiferous (convoluted) tubules which are completely destroyed and distended with exudate, separated by areas of normal and slightly affected tubules which contain

large numbers of mitotic sexual cells, though few mature spermatozoa.

"The exudate in the destroyed tubules consists chiefly of polymorphonuclear leukocytes and phagocytic endothelial leukocytes. The cells of the tubules have mostly undergone a hyaline degeneration and are taken up by phagocytic endothelial leukocytes, though there are occasionally perfectly preserved mitotic sexual cells scattered among the tightly packed exudative cells.

"The intertubular connective tissue everywhere is edematous and between the tubules most affected contains coarse, meshed fibrin, small areas of hemorrhage and many polymorphonuclear leukocytes and endothelial leukocytes.

"Among the groups of least affected tubules there are some with normal epithelium, but with lumina partly filled with polymorphonuclear and endothelial leukocytes, as if the process was spreading along the lumina.

"There are many more tubules, however, which show lesions involving a small portion of the circumference, where it appears as if the process was extending from the intertubular connective tissue. In these places numerous leukocytes are found in the act of migrating through the basement membrane of the tubules. These small lesions contain deeply staining hyaline degenerated sexual cells, hyaline fragments, polymorphonuclear leukocytes and endothelial leukocytes. The immediately adjacent epithelium is usually full of mitotic sexual cells showing the various stages of spermatogenesis.

"The tunica albuginea is edematous, and there are small hemorrhages and zones of cellular exudate about bloodvessels. The cells about bloodvessels are polymorphonuclear leukocytes and endothelial leukocytes.

"Mitotic endothelial cells in the lumina of capillaries occur in the tunica albuginea and intertubular connective tissue.

"Liquefaction necrosis is not present either in the tubules or in the connective structures.

"No bacteria or other parasites can be found in the sections and in film preparations made at the time of operation."

In both cases the blood cultures and the cultures from the hydrocele fluid and testicular tissue were bacteriologically negative.

Thanks to Councilman,<sup>24</sup> we have an admirable description of the pathology of the testicle in smallpox, which I quote at length.

"Lesions most difficult of interpretation are those of the testicle. There is absence of spermatogenesis in the cases in which convalescence is established. Normal spermatozoa are absent in the lumina of the tubules, and there is degeneration of the spermatogenetic cells. This affects both cytoplasm and nuclei and the degenerating nucleus assumes forms which present some similarity to certain of the intracellular parasites in the epithelial cells of the skin. This degeneration is not peculiar to smallpox but may be found in typhoid fever. These lesions are absent in the undeveloped testes of children.

"In addition to diffuse degenerative lesions there are focal lesions as

characteristic of the disease as the skin lesions found in adult and child's testes. Lesions begin as an infiltration of the intertubular tissue with both ordinary lymphoid cells and large mononuclear basophilic cells. The tubules in the foci are unaltered. From such lesions as these, which are best compared with small interstitial foci in the kidneys, the process extends. The area enlarges, the cellular infiltration extends and finally there is complete necrosis in the centre, with fibrin and hemorrhage in the surrounding interstitial tissue. The necrotic tubules often contain numbers of phagocytic cells. The bloodvessels in the foci are obliterated in some cases by thrombi, but chiefly by the pressure of the cells. Acute endarteritis with accumulations of mononuclear cells is often found.

"The lesions vary in number, some testicles showing large numbers of them, while in others they are found only after prolonged search. The smallest lesions and those best adapted for study are in the undeveloped testes of children. They show a general relation to the duration of the disease, the most advanced cases occurring late in the course.

"Notwithstanding its apparently specific nature no parasites were found in the testicular lesions of man."

Secondary infection of the smallpox testicle, at least in the suppurative cases is exceedingly common, for Esmonet,<sup>9</sup> in a number of such cases, found streptococci, pneumococci, colon bacilli, and the *Staphylococcus aureus* alone or associated with the streptococcus.

The pathology of suppuration of the testicle, when due to pyogenic infection, is not peculiar, but it is fair to say that there is little available material on which to base an opinion. In a case operated upon by me, with infection by the *Bacillus mucosus capsulatus* and the streptococcus, practically the whole testicle was occupied by an abscess cavity (Fig. 218). Sections of this testicle, examined for me by Prof. S. B. Wolbach, showed that necrosis had "extended irregularly into the substance of the testicle, following the interstitial tissue." In a second personal case, of colon bacillus origin, the abscess was found to occupy only the upper third of the organ, there being a fairly sharp line of demarcation between this and the rest of the testicle which was but little affected. In still a third case, only the lower third of the testicle was involved in the abscess. The normal-looking upper two-thirds of the organ was left behind, but became necrotic and sloughed out later. In a fourth orchidectomy (a recent case, unreported) I found a comparatively early stage of the infection. The whole testicle was riddled with abscesses of varying size, with tufts of seminiferous tubules sticking out here and there through holes in the tunica albuginea (Fig. 219). A testicle very similar to this, with *Staphylococcus aureus* infection, has been described by Dalous.<sup>7</sup>

I have been unable to find descriptions of the orchitis which is said to occur in influenza, glanders and other infectious diseases, but it seems unlikely that their pathology offers any peculiarities.

From the foregoing consideration of the etiological factors, of the

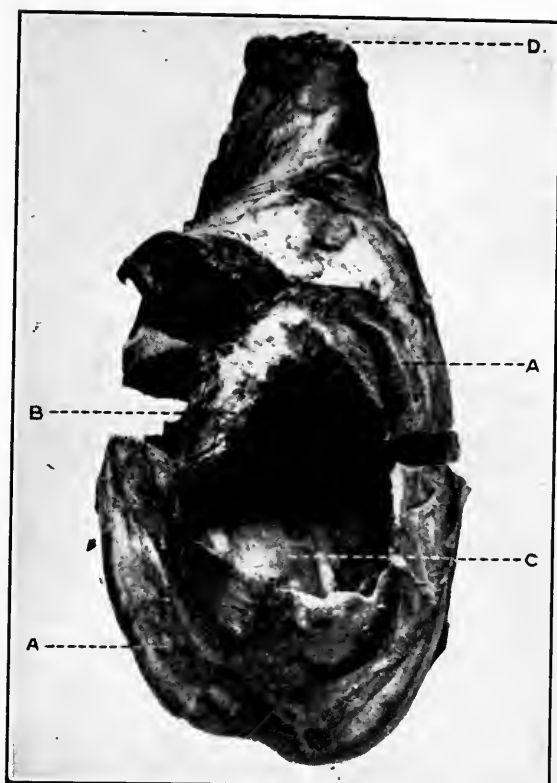


FIG. 218.—Abscess of testicle. Mucosus capsulatus. Author's case. *A*, thickened tunica; *B*, remains of wall of testicle; *C*, abscess cavity in testicle; *D*, epididymis. Anterior view.

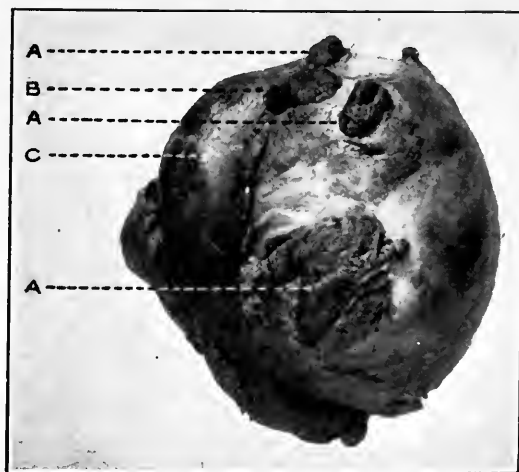


FIG. 219.—Abscess of testicle. No culture. Author's case. *A, A, A*, tufts of seminiferous tubules protruding through tunica albuginea; *B*, hydatid of Morgagni; *C*, epididymis. Lateral view.

probable paths of infection, and of the pathology it is possible to state that acute orchitis can occur under three different conditions:

1. As a localization of a primary infection (mumps, typhoid, syphilis, pyogenic septicemia, etc.).

2. As a localization of a secondary infection in one of the above conditions.

3. As a propagation of a urethritis primary or secondary to a pyogenic infection of the prostate, urethra, or bladder neck.

It must not be forgotten, however, that a severe orchitis may be the result, not of actual bacterial invasion of the organ, but of a bacterial toxemia. The possibility of this has been demonstrated by Esmonet,<sup>9</sup> who produced total necrosis of the testicle (in dogs) by the injection of 15 drops of typhoid toxins. Also in thirteen suppurating testicles of typhoidal origin Kinnicutt<sup>18</sup> found a sterile culture in six. Similar findings are reported in mumps (Smith<sup>32</sup>) and in smallpox (Councilman<sup>6</sup>).

**Symptomatology and Diagnosis.**—These two aspects of acute epididymo-orchitis can be considered together.

In syphilis of the testicle the onset is gradual and generally symptomless, the patient seeking advice largely because of the enlargement of the scrotum. The unilateral, wood-like hardness, involving chiefly the testicle, the complete absence of normal testicular sensation (an important point), and lack of tenderness, the irregular contour, should suggest gumma at once. These findings, together with a positive Wassermann reaction in the blood or cerebrospinal fluid, or other evidences of syphilis, should make the diagnosis clear. The diagnosis is established occasionally only by exploratory incision.

The symptoms of practically every other form of orchitis are those of acute inflammation localized to this organ or at least to the scrotum. The onset may be sudden and the pain intense, concentrating in the testicle or possibly radiating to the groin, back or perineum. In certain cases there is marked constitutional disturbance aside from that occasioned by the general infection from which the patient suffers. The temperature may be considerably elevated (102° to 103° F.) and nausea and vomiting may accompany the attack. In certain cases an accumulation of hydrocele fluid may make the differentiation between orchitis and epididymitis obscure; in others palpation will show a much enlarged, tender testicle, smooth and firm, with an epididymis more or less involved. In the later stages the skin of the much enlarged scrotum may be red, edematous, or in a state of phlegmon, with distinct fluctuation concentrated especially on its anterior surface. The whole spermatic cord may be traced into the groin as a much enlarged conglomeration of vas, vessels, and cremaster muscle, indurated and tender to the touch. The prostate and vesicles may or may not be inflamed, and urethritis (in which organisms other than the gonococcus may be demonstrated) may exist. The urine may be clear and sterile to culture. It may, on the other hand, contain pus together with the organisms of either of the general infection (typhoid, for example) or of

the serotal infection (as in a case of infection with *Staphylococcus aureus* reported by Quénu<sup>29</sup>). Accompanying these phenomena there may be the symptoms of bladder irritability.

A diagnosis of the cause of infection will depend upon circumstances. In the presence of parotitis (which incidentally may be easily overlooked), in the event of smallpox, typhoid fever, or any other definite general infection the nature of the orchitis will be clear. One also would have suspicion aroused if the orchitis arose in the course of tonsillitis or of some localized pyogenic infection.

On the other hand, one must not forget that orchitis may appear spontaneously in a previously healthy individual, as in the case of Du Bois<sup>3</sup> and of Le Fur<sup>22</sup> and in those reported by the writer.<sup>1</sup>

Some difficulty might be encountered at the onset in differentiating between a torsion of the testicle and an orchitis. What begins as a torsion may rarely become an orchitis, owing to the interference with the circulation of the testicle and its subsequent invasion by bacteria. Exploratory incision or the gradual decrease of symptoms under palliative treatment, with atrophy of the testicle, will generally differentiate the two conditions.

**Prognosis.**—The prognosis in acute orchitis may be divided into that for the patient, and that for the testicle involved, with a possible subdivision which takes the other half of the scrotum into consideration.

The outlook for the patient himself depends upon the nature of his infection. In typhoid fever, mumps, smallpox, syphilis or any other general infection, the mortality seems to be not at all influenced by the intervention of an orchitis. I have also seen no account of a death following orchitis when due to pyogenic organisms, whether primary or secondary.

The chances of saving the testicle vary also with the kind of infection, and must be considered from the stand-point of spermatogenesis, as well as from that of internal secretion. If extensive suppuration has taken place orchidectomy will be necessary. In certain cases evacuation of the pus by trocar or simple incision may suffice. It is to be expected, however, that the remaining portions of the testicle will eventually become so atrophied as to be of little or no value to the patient except possibly from a psychic stand-point.

In typhoid fever the combined statistics of Kinnicutt<sup>18</sup> and of Hare and Beardsley<sup>13</sup> show an incidence of suppuration of 22.5 per cent. The percentage of bilateral orchitis is very small (Kinnicutt 0.42 per cent., and Hare and Beardsley 0.44 per cent.). When suppuration does not occur, atrophy, more or less complete, is to be expected, with a consequent destruction of the functional activities, especially spermatogenesis, of the organ. Smith<sup>31</sup> has recently shown us that this is due to a destruction of the arterial supply of one or another portion of the testicle. His case also suggests the desirability of drainage at an early stage of the infection.

In mumps we have seen that orchitis occurs once in about every

three cases. Laveran and Catrin<sup>21</sup> show a bilaterality of 30 per cent., and a subsequent atrophy of 60 per cent. of the testicles so affected. Secondary infection does not seem to be mentioned. Smith's recent work<sup>32</sup> in this affection suggests that the subsequent atrophy, which completely destroys the sexual function of the gland, may be obviated or lessened by early operation. It has been shown that the testicle is attacked by the *Spirochæta pallida* rather infrequently (67 times in 2170 cases, Keyes<sup>17</sup>), and both sides are affected in 6.7 per cent. With proper antisymphilitic treatment the future of the testicle seems to be bright, for we have the word of Gosselin<sup>11</sup> that spermatozoa have been found in the semen after such treatment. Also in the words of Keyes,<sup>17</sup> "Whatever part of the parenchyma has not been destroyed by sclerosis will continue to functionate, and the testicle which has been syphilitic for years may still secrete spermatozoa." Secondary infection is not to be expected.

There seem to be no actual figures at hand as to the frequency of suppuration in the orchitis of smallpox, but if we are to believe Esmonet,<sup>9</sup> secondary infection is not uncommon. We are also left in the dark as to the probability of bilateral infection. The minute pathological picture of these testicles painted for us by Councilman<sup>6</sup> and the apparent frequency of suppurative processes make the prognosis of such an orchitis bad from every point of view.

Pyogenic infection of the testicle, primary or secondary, apart from the diseases already enumerated, seems never to be bilateral. Destruction of the gland is generally so complete as to require its removal. Even successful attempts at conservation will leave behind only a small mass of scar tissue.

**Treatment.**—The physician must be guided in his treatment of the case by local and general conditions.

In typhoid fever and mumps, early and thorough drainage of the tunical sac by incision, and of the epididymis and testicle by multiple puncture, may be considered and, in certain cases, may be necessary. Palliative treatment will probably suffice for most cases, and in the absence of actual suppuration the results may be as good as with drainage.

In the far-advanced cases with free pus and much tissue destruction, orchidectomy is indicated.

In syphilis, salvarsan or neosalvarsan and mercury will produce good, often brilliant results. The knife is indicated but rarely.

In certain mild infections of the testicle the time-honored measures of rest in bed, an ice-bag, and support of the scrotum by a suspensory or an Alexander bandage may suffice.

Combined with these measures, or with surgery, the patient should be given some urinary antiseptic (preferably sandalwood oil or hexamethylenamin), an abundant supply of liquids, a good cathartic, and a light diet.

Meantime if he is suffering from one of the general infections already mentioned the treatment of this should go on as usual.

## BIBLIOGRAPHY.

1. Barney: Surg., Gynec. and Obst., March, 1914.
2. Baumgarten: Verhandl. d. deutsch. path. Gesellsch., 1905.
3. Beardsley: Jour. Am. Med. Assn., March 28, 1908.
4. Belfield: Jour. Am. Med. Assn., October 19, 1912.
5. Biland: Cent. der Harn. und Sexualekrankheiten, 1905.
6. Councilman: Osler and McCrae's Mod. Med., 1913, 2d edition, i.
7. Dalous: Ann. des Mal. des Org. Génito-urinaires, 1905, ii.
8. Du Bois: Rev. Méd. de la Suisse Romande, 1909, No. 11, 800.
9. Esmonet: Thèse de Paris, 1903.
10. Girode: Keen, The Surgical Complications of Typhoid Fever, 1898.
11. Gosselin: Watson and Cunningham, Dis. and Surg. of the Genito-urinary System, 1908.
12. Grendin: Curling, Diseases of the Testis, 3d edition.
13. Hare and Beardsley: Typhoid Fever and Exanthemata, Lea & Febiger, Philadelphia, 1909.
14. Hölscher: München med. Wehnschr., 1891, Nos. 3 and 4.
15. Huet: Cent. f. Bakt., 1909, lii.
16. Joal: Arch. gén. de Méd., 1886.
17. Keyes: Syphilis, 1908.
18. Kinnicutt: Med. Rec., 1901, lix.
19. Kinnicutt: Med. Rec., 1901, lix, 801.
20. Lasègue: Traité des Angines, Paris, 1868.
21. Laveran and Catrin: Bull. et mém. Soc. Méd. des hôp., Paris, 1894, xi, 108.
22. Le Fur: Bull. Assn. française d'Urologie, Paris, 1909.
23. Liebermeister: Ziemssen's Handbuch d. spec. Path. u. Therap., 1874, ii, Bd. ii, 189.
24. McCrae: Osler and McCrae's Mod. Med., 1912, i, 2d edition.
25. Osler: Pract. of Med., 1901, 4th edition.
26. Pike: Am. Jour. of Dermat. and Genito-urinary Diseases, xv, 202.
27. Picqué and Worms: Jour. de l'Anat. et de la Phys. norm. et path., 1909, i, 51.
28. Prouty: Jour. Am. Med. Assn., 1912, viii, 1192.
29. Quénu: Presse Méd., 1909, xvii, 281.
30. Roger: Esmonet, Thèse de Paris, 1903.
31. Smith: Boston Med. and Surg. Jour., 1912, clxii, No. 10, 323.
32. Smith: Tr. Am. Urol. Assn., 1912, vi.
33. Sorel: Bull. et mém. de la Soc. méd. des hôp., Paris, 1889, lvi, 236.
34. Testut: Traité d'Anat. Humaine, Paris, 1897.
35. Verneuil: Arch. gén. de Méd., 1857.
36. Von Biede and Kraus: Zeit. f. Hyg., 1898, xxvi, 353.
37. Welch and Schamberg: Acute Contagious Diseases, 1905.

## CHAPTER XVI.

### GENITAL TUBERCULOSIS.

By J. DELLINGER BARNEY, M.D.

**Introduction.**—Tuberculosis of the genital tract in the male commences in the epididymis. Thence it spreads, at a fairly early date, to prostate and seminal vesicles, and, in some cases, attacks the testicle and the bladder. The vas deferens becomes involved to a greater or less extent in practically all cases. It is a characteristic of the disease to attack the opposite epididymis in over half the cases, within a year or two of the time of involvement of the first side. This catastrophe occurs in spite of all efforts to prevent it, but early excision of the epididymis first attacked will improve the chances for the escape of its fellow.

Primary tuberculosis of the prostate, seminal vesicle, testicle, penis and urethra is occasionally reported. While there are a very few undoubted examples of such lesions, most of those reported are open to criticism and can be disregarded.

Genital tuberculosis in adults is found in from 2 to 5 per cent. of all tuberculous subjects. It is much less frequent in children. In over 50 per cent. of cases there will be found old or active foci in other organs, especially the lungs. The urinary tract is often involved with the genital tract, but careful inquiry will show that involvement of the one system preceded that of the other. In my experience, when both are diseased, the genital tract has been first attacked.

While proof is lacking of the exact mode of onset of the disease in the genital tract, it seems probable that the tubercle bacillus reaches the epididymis by way of the blood stream, and that the testicle and epididymis may possess an excretory function. The means of transmission of the disease to the other genital organs is still more in dispute. It seems probable that the lymphatics, especially those of the vas deferens, serve as a bridge between epididymis, prostate, and seminal vesicle. A similar route is probably taken from epididymis to testicle. Involvement of the second epididymis takes place in the same way as that of the first side, or by the transmission of the bacilli from the already infected prostate and seminal vesicle through the lymphatics of the second vas, but in a direction opposite to that of the normal flow.

The pathological features of tuberculosis of the genital tract are not essentially different from those of the disease in other organs. Its characteristics are marked chronicity, a strong tendency to sinus formation, and a gradual replacement of the normal structures by dense connective tissue.

After the removal of one or both epididymes the tuberculous process in the prostate and seminal vesicles generally becomes quiescent and a clinical cure is established.

While the tubercle bacillus is directly responsible for the disease, there are certain contributing factors of importance. Trauma, a previous infection (generally gonococcal), and ectopia of the testicle may serve to reduce the local resistance. The young adult is most often attacked, but cases have been reported in infants on the one hand, and in men over 80 on the other.

Most cases seek treatment within 6 months of the supposed onset of the disease, but its beginnings are generally so insidious that the onset is difficult to determine. Affections of the second epididymis occur in from 40 to 75 per cent. of all cases, while the prostate and seminal vesicles are attacked in at least 75 per cent.

It will be found that most patients have lost weight, owing, no doubt, to the involvement of other organs which is so often found. Pain is to be expected at some stage in the disease, but like tenderness, it is intermittent and often mild. Bladder symptoms and a pathological urine are found in a considerable number. Scrotal fistule are seen in over three-fourths of the cases, while the testicle proper is invaded in about 66 per cent.

While the sexual desire and potency seem rarely to be impaired, even after double orchidectomy, azoöspemia, due to occlusion of some portion of the genital duct, is found in a very large percentage.

The diagnosis of a typical case of tuberculosis of the epididymis is easy. Differential diagnosis may be extremely difficult, and sometimes can be settled only by exploratory incision.

The prognosis is, on the whole, unfavorable. In our own cases there has been an operative mortality of 2.66 per cent., comprising 4 deaths, all of general miliary tuberculosis. Over 27 per cent. of 113 cases, traced from one to twenty-five years after operation, have died of some form of tuberculosis. My experience shows that until at least ten years have elapsed after operation, no patient can be said to be cured of genital tuberculosis.

If the technic of epididymovasectomy, now employed by us at the Massachusetts General Hospital, is done, and if it is performed, not under ether, but with novocain, local anesthesia or with gas-oxygen, operative mortality, postoperative sinuses in groin and scrotum, and the necessity of secondary orchidectomy will be practically eliminated.

Treatment should consist of conservative surgery, combined with hygiene and tuberculin. The epididymis and accessible portion of the vas should be excised, together with the tunica vaginalis and other tuberculous tissues in the scrotum. The testicle may be freely explored, and, if tuberculous, the diseased portions may be removed by curette or knife. Orchidectomy is rarely necessary.

**Incidence of Tuberculosis.**—The statistics of the world show tuberculosis to be one of the most common and fatal of all diseases. Cornet<sup>26</sup> says that in 1894 in Germany the death-rate from tuberculosis was 25

per 10,000, while in 1908 the number fell to 16.24. From 1896 to 1900, 108,664 died of tuberculosis of the lungs, while in 10,000 this disease was found in other organs.

From 1900 to 1909 the deaths in the registration area of the United States were 159.4 per 100,000 from lung tuberculosis alone, and 182.6 per 100,000 from tuberculosis of all organs. In Massachusetts, for 1912, the deaths from lung tuberculosis alone were 131 per 100,000, and in Boston, for 1913, 144.7 per 100,000. Unfortunately, there seem to be no available national, State or municipal statistics which give satisfactory details of the distribution of the disease among the different organs and tissues.

**Incidence of Genito-urinary Tuberculosis.**—Hesse<sup>26</sup> has collected a large mass of statistics on the frequency of urogenital tuberculosis. In 10,864 autopsies, lesions of the genito-urinary tract were found in 2.13 per cent. Krzywicki,<sup>40</sup> in 500 autopsies on tuberculous subjects, found 5 per cent. with involvement of the urogenital tract. Fowler and Godlee<sup>72</sup> found 5.27 per cent., and Reclus,<sup>52</sup> many years before, reported 12.8 per cent.

Quite startling is the statement of Uchimura,<sup>67</sup> that in 1830 autopsies on Japanese subjects, he found 629 cases of tuberculosis, the urinary or genital tract being involved in 210, or 33 per cent.

The above figures apply largely, if not entirely, to adults. In children the urogenital system is far less frequently attacked.

Ritter,<sup>28</sup> in 1909, found but 14 cases among 5000 tuberculous children; Molliere and Augagneur,<sup>68</sup> 1 instance in 183 cases of lung tuberculosis. The figures from other sources give a proportion of urogenital tuberculosis in infants and children of about 1 in 200 cases of general tuberculosis.

**Tuberculosis of the Genital Organs.**—The compilation of statistics is made a little difficult for the reason that the terms "genito-urinary" and "urogenital" tuberculosis are loosely used by almost all writers, and the general profession is only too apt to class under one of these names, an infection of the genital tract alone. While both the genital and urinary organs may be involved, careful inquiry will show infection of the one tract to be secondary to that of the other. While opinion is practically unanimous that the kidney is the first organ to be attacked in infections of the urinary system, there is less unanimity in the matter of the genital system. Most authorities now agree that the primary focus is in the epididymis, but certain others still believe that the infection begins in the prostate.

In an analysis of 154 cases of epididymal tuberculosis from the Massachusetts General Hospital, the writer<sup>5</sup> found tuberculosis of the kidney in 18. Of these, the genital lesion preceded the renal infection in 11, whereas in 7 the kidney was first involved.

Keyes<sup>33</sup> has reported 100 patients bearing 153 tuberculous epididymes. Among these renal tuberculosis had preceded the genital lesion in 11 cases, while extension of genital tuberculosis to the kidney took place 9 times.

From our material and from the literature, I have gathered 1862 cases of genito-urinary tuberculosis. Most of them are infections of the genital tract alone, in others the urinary organs are also involved. Certain valuable deductions can be made from so large a mass of material.

Out of 821 cases in which the condition of the epididymis was described, 617, or 75.1 per cent., were tuberculous.

The prostate and vesicles together were said to show tuberculosis in 1169 out of 1675, or 69.7 per cent., while disease of the testicle was noted in 57.6 per cent. of 739 cases.

It is therefore quite evident that next to the epididymis, the prostate and vesicles are most frequently attacked, a conclusion borne out by still further data. Hesse's<sup>26</sup> statistics comprise 815 cases of urogenital tuberculosis collected from 17 different authors. The prostate was tuberculous in 559, or 68.5 per cent. According to Burekhardt,<sup>25</sup> the prostate is invaded in 73 per cent. of all cases of genito-urinary tuberculosis, a statement based upon the investigation of much material. As the only clinical method of detecting foci in the prostate is by digital examination, there is a certain percentage of error, an observation which I find agrees with that of Hallé and Motz.<sup>25</sup> This error lies generally in the detection of small, early, and centrally located lesions.

Certain authors claim to have found isolated prostatic lesions in considerable number. Out of a possible 642 cases I find that the prostate alone was regarded as tuberculous in 21.6 per cent. On the other hand, Saxtorph,<sup>58</sup> in a series of 205 cases of genito-urinary tuberculosis, has reported only 9 such lesions, and Sawamura,<sup>56</sup> from various sources, collected but 11 more. After considering all the evidence, and with a large clinical and laboratory experience of his own, he thinks that the primary focus of genital tuberculosis may arise in the prostate, an opinion shared by K. M. Walker.<sup>71</sup>

On the other hand, in 1911 George Walker,<sup>70</sup> whose opinion is backed by much experimental work, has laid much stress on the rarity of primary prostatic tuberculosis, and after reviewing the literature with great care, found only 3 cases in which the primary focus undoubtedly lay in the prostate. One was reported by Crandon,<sup>17</sup> and 2 others by Krzywicki.<sup>40</sup> Practically all the other authors mentioned above, who claim to have found isolated prostatic tuberculosis, have based their conclusions either on clinical evidence, or upon the fact that although other foci were present in the genital tract, those of the prostate were further advanced and more extensive. I have already pointed out that clinical evidence is unreliable, and the consensus of opinion of experienced pathologists is that the apparent age of a tuberculous process does not necessarily determine its priority. I do not recall a single proved case in the course of ten years in the genito-urinary clinic at the Massachusetts General Hospital, nor am I aware that the autopsy records of the hospital contain one.

We have seen that the seminal vesicle, like the prostate, is invaded secondarily by tuberculosis with great frequency. Primary lesions, on

the other hand, are apparently almost as rare as those of the prostate. This view is somewhat shaken by the fact that in 28.5 per cent. of 287 cases, of the series of 1862 mentioned above, the seminal vesicle alone was said to be tuberculous. But what was said of the so-called isolated prostatic lesions, applies to those of the vesicles, and careful scrutiny would undoubtedly eliminate most of the reported cases.

Guisy<sup>23</sup> found only 1 instance in 86 cases of genito-urinary tuberculosis, while Saxtorph<sup>58</sup> discovered but 2 examples. Dreyer<sup>20</sup> has found 2 specimens at autopsy in which the only tuberculosis of the genital tract was in the vesicles. Teutschländer<sup>64</sup> cites another example.

Primary tuberculosis of the testicle is conspicuous for its rarity. K. M. Walker and Hawes<sup>72</sup> accept as authentic cases reported by Dufour,<sup>72</sup> Langlet<sup>72</sup> and Schmidt,<sup>72</sup> while that of Barling,<sup>70 72</sup> is vouched for by these authors, as well as by George Walker.<sup>72</sup>

Tuberculosis of the glans penis may rarely occur: (1) as an isolated lesion, (2) in association with tuberculosis of the genito-urinary tract or elsewhere, (3) by direct infection (circumcision, coitus). George Walker<sup>70</sup> has collected 5 cases in the first group, 3 in the second group, and says "several (instances of infection from circumcision) have been noted in the Johns Hopkins Hospital." He has collected some 31 others from other sources. I have not seen an example of it.

The question of infection from coitus has raised extensive discussion. Pinaud<sup>51</sup> cites 4 cases of tuberculosis of the penis from fellatio. Frank<sup>51</sup> and Kraemer<sup>51</sup> regard tuberculosis of the penis from normal coitus as impossible; on the other hand, Senn,<sup>51</sup> Oberndorfer<sup>51</sup> and Williams<sup>51</sup> regard such an infection as possible.

Although there seems to be no authentic case of primary urethral tuberculosis, a secondary infection is seen occasionally in the course of tuberculosis of the genito-urinary tract. I have operated upon such a case, and there have been two others in the genito-urinary clinic at the Massachusetts General Hospital during the past year. Asch,<sup>1</sup> Sawamura,<sup>56</sup> Uchimura,<sup>67</sup> Hallé and Motz<sup>25</sup> and others report several instances. Such strictures often accompany bilateral renal tuberculosis.

Tuberculosis of the vas deferens is found sooner or later in practically all epididymal lesions, especially on the side first involved. Infections of the second vas are not so common and develop later in the disease.

Tubercle bacilli have been found in human semen, and in that of animals, by numerous observers. In some cases there was tuberculosis of the urogenital tract, in others tuberculosis of the lungs, but healthy genitalia. George Walker,<sup>70</sup> after a careful review of all the literature of this subject, thinks that while tubercle bacilli may well find their way into the semen in the event of tuberculous genitalia, there is no positive proof that they can be secreted by healthy organs. The subject is of some importance, as undoubted examples of vaginal and cervical tuberculosis, arising apparently from sexual contact, have been reported.

**Tuberculosis of Other Organs.**—The frequency of a tuberculous infection of other organs, preceding or accompanying that of the genital tract, is well recognized.

In my series of 154 cases of tuberculosis of the epididymis, tuberculosis of organs other than those of the genito-urinary tract was found in 55.8 per cent. The lung was most frequently diseased, with a total of 35 cases, 22.7 per cent. of the whole. Kidney and bone infections came next, with 7 cases each. I have also shown elsewhere<sup>3</sup> that the disease, quiescent or active, may be found in the joints, larynx, glands, meninges, middle ear, peritoneum and ischio-rectal fossa. It will be found in many cases that these lesions have preceded, often for several years, the tuberculosis of the urogenital tract.

Keyes<sup>33</sup> found a previously existing process in 36 out of 100 cases; as he gracefully puts it, the disease is always "flitting between bone and lung and urinary tract." Simmonds<sup>26</sup> in 35 cases of genito-urinary tuberculosis found lung infection in 27, Steinthal<sup>26</sup> in 24 cases found the lungs involved 22 times, and Socin<sup>26</sup> 42 times in 52 cases of genito-urinary tuberculosis. In 37 cases of the latter, Oppenheim<sup>26</sup> found 81 per cent. of lung involvement, while in Reclus<sup>52</sup> cases it was present in 66 per cent.

The percentage of tuberculous lesions outside the genital tract is therefore very high, and a lung process which has escaped the memory of the patient and the observation of the surgeon may not infrequently be uncovered by the unwise choice of ether as an anesthetic.

**Pathogenesis.**—The question as to how the tubercle bacillus reaches the primary focus in the genital tract is not yet definitely settled; still more in doubt is the path taken by the disease to its secondary foci.

I have shown that the relationship between genital tuberculosis and that of other organs, especially the lung, is very close, but there are occasional exceptions to this rule.

Baumgarten,<sup>9</sup> v. Bruns,<sup>69</sup> Kocher,<sup>34</sup> v. Braman,<sup>2</sup> Durante<sup>2</sup> and Ziegler<sup>2</sup> have reported cases in which tuberculosis of the testis and epididymis was the only demonstrable focus in the body, while Kowalewsky<sup>37</sup> and Kraenzle<sup>37</sup> have found isolated, primary tuberculosis of the testicle (epididymis?) in bullocks. These are the only instances I have found of isolated genital tuberculosis.

I have no doubt that in the majority of cases the disease reaches its primary focus in the genital tract by way of the blood stream. Its attack upon the epididymis, the testicle or the seminal vesicle may be accounted for by the supposition that these organs have an excretory function, and that the disease gains a foothold upon a given organ at one time and not at another, because of either an overdose of the bacilli, or of a lowered resistance on the part of the gland involved.

From an embryological stand-point, the testicle and the kidney are much alike, and there is ample proof that the latter may allow the passage of tubercle bacilli and other organisms without injury to itself.

The filtration of bacteria through an apparently healthy kidney has been demonstrated by many observers, among them, Meyer,<sup>47</sup> Heyn,<sup>72</sup>

Kraemer,<sup>39</sup> Buday,<sup>14</sup> Wyssokowicz<sup>74</sup> and Rolly.<sup>53</sup> More recently Brown<sup>13</sup> has collected many instances of lung tuberculosis, some in his own practice, where tubercle bacilli were found in the normal urine, and where, later, the kidneys were shown to be free from disease.

Belfield<sup>11</sup> has shown that the testicle and epididymis are excretory organs. He says, "While the kidney is provided with a new and private sewer, the ureter, the testis continues to use the frog's old urinary duct, now called epididymis and vas deferens. This excretory function of the testicle and its duct illumines both its intimate alliance with the kidney and its frequent infection from the blood." The writer<sup>6</sup> has already shown in a study of infections of the testicle, that in certain cases the presence of organisms in both testicle and epididymis could be accounted for in no other way than by assuming that these organs had an excretory function.

There seems to be also considerable evidence that the seminal vesicle can assume an excretory role, not only for tubercle bacilli, but for other organisms as well.

Huet's<sup>23</sup> experimental work has shown not only that bacteria are present in the secretion of the seminal vesicles of healthy animals, but also that in animals dying of acute sepsis the specific organism may be found in this secretion. The seminal vesicle may thus be looked upon not only as a reservoir for spermatozoa, and a secretory organ, but also as an excretory organ. Hueter,<sup>29</sup> Simmonds<sup>2</sup> and Spano<sup>61</sup> share this view.

There seems to be some evidence that the prostate also plays the part of an excretory organ. Jani and Nakarai,<sup>56</sup> in 1886 and 1898 respectively, found tubercle bacilli in the normal prostate of patients dying of lung tuberculosis.

I have seen a number of cases of acute infection of the prostate with the *B. coli*, there being no demonstrable focus of infection either in the kidneys, the bladder, or the external genitals. I have regarded this infection as hematogenous, but whether it is to be regarded as an excretory effort on the part of the prostate I am unable to say.

Admitting that the epididymis is the primary focus, is the subsequent prostatic infection of hematogenous, deferential, or lymphatic origin?

While the tubercle bacillus may, in certain cases, be carried from epididymis to prostate by the blood stream, it is more likely that the more direct route offered by the vas deferens, or by the lymphatics is responsible.

At first sight it would appear that the spread of the disease through the vas in the direction of the seminal stream, the descending, or, as some miscall it, the ascending route, offered an easy explanation for the early and frequent prostatic involvement. While this view has many proponents, it is strongly assailed by numerous competent observers. Baumgarten<sup>8</sup> and his pupils, especially Kraemer,<sup>33</sup> have been the chief proponents of the descension theory, this opinion being based on much experimental and clinical observation. Among others who hold this

view are Tylinski,<sup>66</sup> Cholzoff,<sup>16</sup> Sugimura,<sup>62</sup> Sangiorgi,<sup>55</sup> Sawamura<sup>56</sup> and Götzl.<sup>22</sup>

While K. M. Walker<sup>71</sup> regards genital tuberculosis as primary in the prostate, certain of his observations, both experimental and clinical, show that a flow of infected secretions through the lumen of the vas from the diseased epididymis may occur. This sets up a tuberculous process in the vas, most marked at its epididymal extremity, gradually shading off to normal tissue (unless the disease is of long standing) toward the external inguinal ring. My own observations and those of others have repeatedly borne out the truth of this observation. The only question is whether the advance of the disease has been intracanicular or intramural.

Although in certain instances, the advance of the tubercle bacillus through the vas is possible, no positive proof can be shown, and the opponents seem to have the best of the argument. The fact that tuberculosis of the vas often obliterates its lumen near the epididymis before the upper part is involved, thus stopping the stream of secretion, at once places the proponents in an awkward position. Furthermore, how are they to account for the fact that even if the vas is ligated, the advance of the disease from epididymis to prostate may be delayed, but not stopped? This phenomenon has been observed in a number of animals by George Walker.<sup>70</sup> How also, are they to explain my observations and those of Balliano,<sup>2</sup> that the epididymis, prostate and vesicles may be tuberculous and the intervening vas perfectly normal?

These observations can be explained only by discarding the idea that the disease spreads through the lumen of the vas, except in certain instances, and by adopting the view that the lymphatics of the vas itself are to be held accountable for the spread of the disease in most cases, for, according to Testut,<sup>63</sup> the lymphatics of the vas are very rich and voluminous, extending throughout its course.

This hypothesis explains the phenomena just cited, as for example, the invasion of the prostate by tuberculosis in the presence of a normal or of a ligated vas. The possibility of this is explained by K. M. Walker<sup>71</sup> who says: "The bacillus of tubercle does not always indicate its presence in the tissue by the production of a tuberculous lesion."

"Structures may be shown under the microscope to be absolutely free from signs of tuberculosis, and yet, nevertheless, have furnished the path along which the tuberculous invasion has progressed."

In certain cases of long duration, the whole spermatic cord may be involved, so that attempts to separate the vas from it may be either difficult, where there are dense adhesions, or impossible, where all the structures are imbedded in dense connective tissue. But in many early cases, one may find an involvement of the prostate and vesicles in the presence of a normal or but slightly affected spermatic cord.

Although every argument presented here, for and against the vas and its lymphatics can be refuted, I think the evidence at hand favors the lymphatic transmission of tuberculosis from epididymis to prostate. I think the stream of secretions in the vas deferens is too scanty and slug-

gish to be a factor in the passage of bacilli. In such an event, with organisms in contact with the entire length of the vas, we should find one end quite as much involved as the other. But such is not the case. The epididymal extremity is first and most seriously invaded, the pathological changes usually disappearing entirely as the inguinal canal is approached. To my mind this phenomenon is an evidence that the disease travels by way of the lymphatics.

I have already pointed out that tuberculosis of one epididymis is followed sooner or later by an involvement of its fellow in a large percentage of cases. I have been unable to settle the question as to the manner of invasion of the second side in spite of much clinical observation, nor do I find that the extensive experimental work of others throws much light on the matter. The paths of communication—vascular, deferential and lymphatic—are the same as before, but the infection is now undoubtedly influenced by the presence of an already tuberculous prostate and seminal vesicle.

Many (Simmonds, Bungner, Kraemer, Bruns, Friedländer, Volkman, Jordan and Zamurawkin, all quoted by Tyliniski<sup>66</sup>) believe that the infection of the second side, like that of the first, is hematogenous. Cholzoff<sup>16</sup> also inclines to this view. The possibility of it cannot be denied.

While the ability of the tubercle bacillus to pass through the vas in the direction of its current has been shown to be doubtful, the chances of its proceeding against the current must be even less. Yet I find that Ziegler,<sup>2</sup> Teutschländer,<sup>64</sup> Kuhn,<sup>41</sup> and Kocher<sup>35</sup> consider this possible not only for the tubercle bacillus but also for the gonococcus and other non-motile organisms. A few of George Walker's<sup>70</sup> experimental results with tuberculosis and a few clinical cases cited by him seem to bear out this view. If the passage of these organisms through the vas from urethra to epididymis does occur it can be accounted for only by a reversal of the normal peristalsis of that structure, a phenomenon carefully studied by Oppenheim and Löw.<sup>49</sup> It was observed in rabbits and guinea-pigs and in one or two humans, but did not occur in dogs. It was produced by stimulation of the hypogastric nerve or by irritation of the verumontanum. Its experimental production is evidently not constant; clinically, it is certainly rare.

Epididymitis of gonococcal or pyogenic origin is occasionally seen, when the sudden onset, a few hours after some otherwise trivial injury (such as the passage of a sound) cannot well be accounted for in any other way. I have never seen a tuberculous epididymitis begin thus, perhaps because the organism develops so slowly. Moreover, if a tuberculous process can, as has been shown, obliterate the epididymal end of the first vas, it can, by the same token, occlude the urethral end of the second vas by tuberculosis spreading from prostate or vesicles. Proof of this is offered by my observations<sup>3,4</sup> and those of Keyes<sup>33</sup> that a very large proportion of men with tuberculosis of even one epididymis have azoöspemia, indicating an obstruction of the genital duct on both sides. The pathological studies of K. M. Walker<sup>71</sup> bear out this belief.

I should like to think with König,<sup>36</sup> Lancereaux,<sup>66</sup> Schmidt,<sup>59</sup> and Sawamura<sup>56</sup> that the infection of the second epididymis is a simple case of transmission through vas, urethra, and vas, but the evidence against it is unimpeachable.

Unless one takes the view, as I am strongly inclined to, that the infection of the second epididymis occurs through the blood stream, possibly as an excretory phenomenon, the question narrows itself down, as in the case of the first epididymis, to the lymphatics as being the most probable bridge between prostate and epididymis. It is true that in such an event the infection must travel in a direction contrary to that of the normal lymph stream, but Balliano<sup>2</sup> has shown that this can take place.

The following case, recently seen (September 15, 1915) by my colleague, Dr. Hugh Cabot, furnishes apparently substantial proof of the soundness of this theory:

A man, aged nineteen years, noticed a swelling of the right side of the scrotum about two years ago. In May, 1915, the right testicle was removed by another surgeon for tuberculosis, the vas being divided at a point opposite the external ring. About two weeks ago the left side of the scrotum became swollen and tender.

Examination showed the right testicle missing. A sinus led to the stump of the vas, which was surrounded by a mass of indurated tissue. On the left side the testicle and epididymis seemed normal, but at the top of the scrotum, close to the vas and evidently connected with it, there was a hard, nodular mass the size of an English walnut. The urine was clear, but contained a few shreds.

Operation October 11, 1915. Left epididymis and testicle apparently perfectly normal. The lower end of the vas near the epididymis not thickened. Near the top of the scrotum there was an indurated mass, adherent to the vas and spermatic cord as well as to the overlying skin. This was excised, together with the epididymis and vas, up to the external inguinal ring. An additional length of vas was then removed through a counter-incision opposite the internal inguinal ring. The inguinal portion of the vas showed two caseous nodules, one of which was removed. The vas was torn off (accidentally) at the second (distal) nodule, which could not be reached over the pelvic brim.

The inguinal canal on the right side was then opened. The vas was isolated, drawn up over the pelvic brim, ligated and divided, thus removing the inguinal portion, together with the mass of inflammatory tissue surrounding its stump.

The tissue excised from both sides is clearly shown in the accompanying photograph (Fig. 220).

Careful microscopic examination of the left epididymis shows no evidence whatever of tuberculosis or other inflammatory change. Sections of the left vas lying between the epididymis and the large tuberculous mass (Fig. 213) are likewise normal. Beyond this point the vas shows various tuberculous changes.

The excised portion of the right vas also showed tuberculous changes.

Fortunately for our purposes the patient was seen when the advance of the disease upon the second side was in its initial stages and before the epididymis was involved.

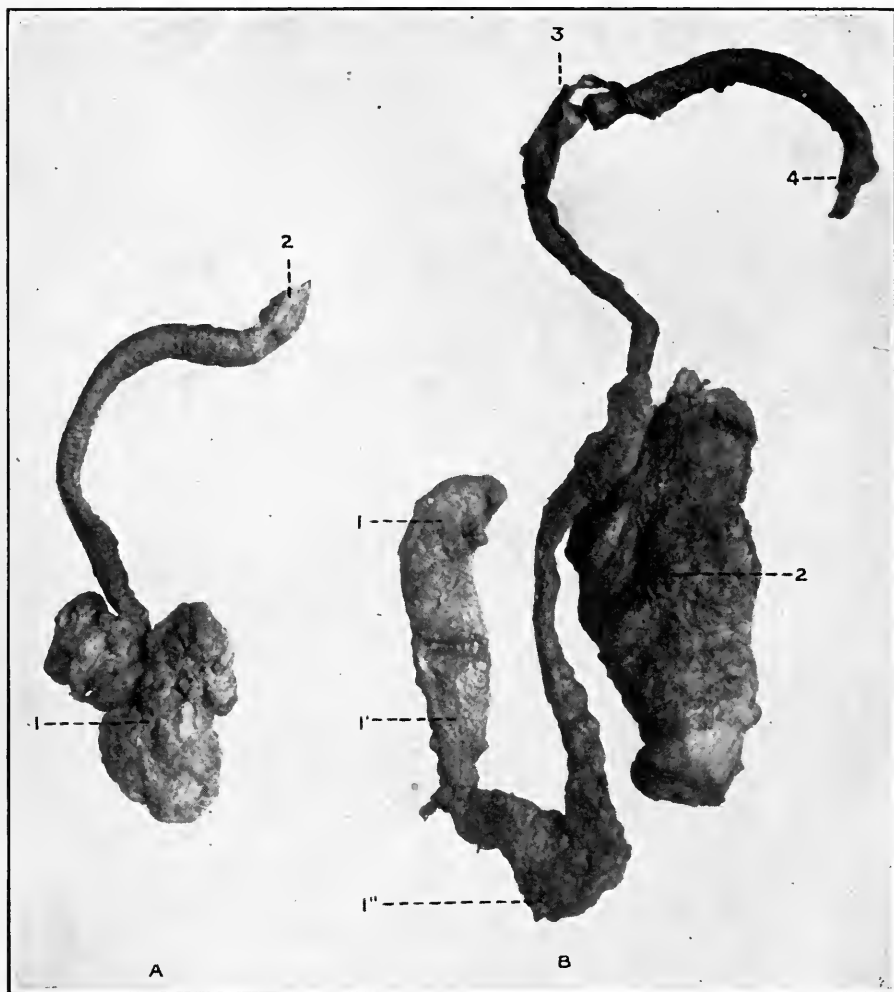


FIG. 220.—A, right vas; 1, proximal end with surrounding sinus; 2, distal end, divided at internal inguinal ring. B, left epididymis, upper pole 1, body 1', lower pole 1''. Mass of tuberculous tissue at upper part of scrotum, 2; caseus, spindle-shaped nodule, 3; lying within thickened vas, 4.

Delli Santi<sup>19</sup> injected tubercle bacilli into the urethra, and after three days demonstrated their presence in the testicle. Paladino-Blandini<sup>20</sup> obtained similar results. K. M. Walker and Hawes<sup>72</sup> injected *B. prodigiosus*, *Staph. aureus*, and other organisms into the urethra of guinea-pigs. Eight to ten hours later they obtained cultures of these organisms from both epididymes, and got a scanty growth from the

testicles and seminal vesicles. Especially important is the fact that positive cultures were obtained from the lymphatics of the vas deferens. Tubercle bacilli have also been demonstrated in the peridifferential lymphatics by Cholzoff.<sup>16</sup>

Furthermore, it has been shown experimentally by Kappis<sup>32</sup> and Baumgarten<sup>10</sup> that the spread of tuberculosis in a direction opposite to the normal stream of secretion can occur only if that stream is stopped. These observations coincide with the fact already noted, that the vasa deferentia are very frequently obstructed on both sides early in the disease.

When the prostate, testicle, or seminal vesicle is the primary seat of genital tuberculosis there is no reason to suppose that its origin is different from that of the epididymal process.

In the event of renal tuberculosis, or of the filtration of tubercle bacilli through the healthy kidney, the prostate may be first invaded, with subsequent epididymal involvement, or the epididymis may be directly attacked. In either event the tubercle bacillus doubtless follows the same paths to the first epididymis which have been regarded as probable in infections of the second side.

Tuberculosis of the testicle, secondary to that of the epididymis, may arise either by continuity, by spreading against the seminal stream through the epididymal tubules or through the lymphatics. Here, again, the latter course seems to be the most likely, but actual proof is lacking. Yet it is significant that the most frequent site of secondary testicular involvement is the body of Highmore at which point the lymphatics of the testicle concentrate (Téstud<sup>63</sup>).

**Pathology.**—The microscopic picture presented by tuberculosis of the genital organs differs little from that seen in other tissues. Whereas elsewhere, notably in the lung, a tuberculous focus may often wall itself off and heal spontaneously, the tubercle bacillus seems never to cease its activity once it enters the genito-urinary tract. In certain cases it may remain quiescent for a long time (especially in the epididymis) bursting forth now and again with surprising violence, all the while replacing the normal tissues of the organ by a process of caseation and cicatrization.

It has been my observation that the tuberculous process attacks first the lower pole or tail of the organ: Cholzoff,<sup>16</sup> K. M. Walker,<sup>71</sup> and George Walker<sup>70</sup> report a similar experience. The early stages of epididymal tuberculosis have been well described by the latter in his experimental work. He says: "The initial lesion begins just under the epithelial layer of the tubules. Soon there is an infiltration of the epithelium by small round cells, a few epithelial cells and leukocytes. This process progresses, the whole lining becomes disintegrated, and the lumen of the tubules is filled with exfoliated and adventitious cells. These soon die and are converted into tuberculous debris. The connective tissue framework becomes invaded secondarily, although there is an almost complete destruction of the epithelial lining before the connective tissue wall is affected."

The relation of the early stages of the tuberculous foci to the tubules

has also been pointed out by Cholzoff,<sup>16</sup> but Tyliniski,<sup>66</sup> in tuberculous testicles of dogs, showed the tubercles to be in the interstitial connective tissue, especially in the neighborhood of blood effusions. An examination of a large amount of the material from our clinic has shown, generally speaking, that the tuberculous process was intertubular, involving only the surrounding connective tissue and leaving the tubules intact. In many sections the tubules were more or less compressed by the encroaching peritubular process, and in the later stages they showed evidence of complete destruction. The tendency of the tuberculous epididymis to form abscesses and sinuses is generally recognized. These will generally be found at the lower pole of the organ (Fig. 221), but in certain extensively diseased epididymes, purulent foci and even sinuses are to be seen at the upper pole as well, and occasionally in the intervening portion.

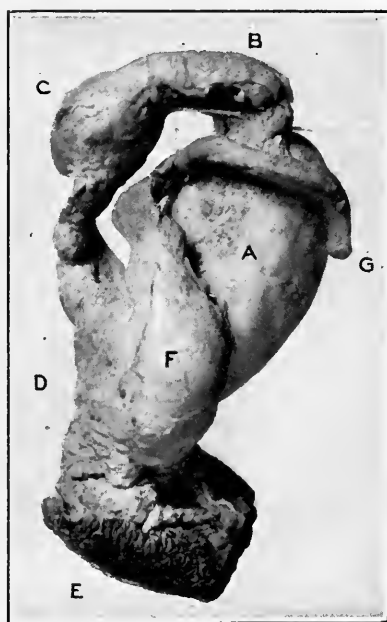


FIG. 221.—Dissection of tuberculous epididymis. *A*, testicle; *B*, upper pole of epididymis; *C*, body, with tuberculous nodule; *D*, much enlarged lower pole, connected by a sinus with scrotal skin (*E*); *F*, nodular and thickened lower pole of vas; *G*, cut end of vas, slightly thickened. (Specimen from Warren Museum.)

It is apparently still unsettled whether the initial tuberculous process in the testicle begins in the canals or in the interstitial tissue. Many competent observers, Baumgarten,<sup>8 10 19</sup> Cholzoff<sup>16</sup> and others think it always commences in the canals or in their neighborhood, whereas Samuel,<sup>54</sup> after a careful pathological study of human testicles, concluded that the disease spread by way of the interstitial tissue. George Walker's<sup>70</sup> experimental work throws light on this question. He says:

"In those cases in which the animals had received injections into the aorta and had been killed within a short time afterward, I found in one gland several small capillaries containing tubercle bacilli, and in another I observed very young tubercles close to the bloodvessels. It is presumable from this that the organisms penetrate the walls and form a tubercle in the immediately surrounding tissues. This process may occur in the intracanalicular connective tissue or just under the epithelium. As the process advances, the tubercles coalesce and form distinct nodules."



FIG. 222.—Longitudinal bisection of testicle extensively invaded with tuberculosis. The disease follows roughly the fibrous septa of the organ. The bisected upper and lower poles of the epididymis are seen above and below in the median line. (Specimen from Warren Museum.)

Balliano<sup>2</sup> recognizes two forms of tuberculosis affecting the testicle and epididymis. The usual type is that which settles primarily in the epididymis, with the formation of single nodules. This soon goes on to caseation, abscesses and sinuses, and is to be regarded as of hematogenous origin. The disease arises primarily in the interstitial tissue. The second type, evidently rare, arises through the natural channels, urethra, prostate, and vas. It generally attacks epididymis and testicle simultaneously, has its primary seat in the interior of the seminal canals, and gives rise to an increase of interstitial tissue with round-cell infiltration and general increase of sexual tissue. It somewhat re-

sembles sarcoma. In advanced states there is caseation and destruction of the organ. But if the resistance of the individual is high a clinical cure may occur, with induration of the organ (orchitis fibrosa) resembling the obliterated and scarred tuberculous foci of the other organs so often seen at autopsy.

The question of spermatogenesis in a tuberculous testicle has received much attention. It may persist until late in the disease. Orth<sup>54</sup> says that in a tuberculous human testicle, of which the centre showed complete caseation, one could recognize clearly the necrotic walls of the tubules, and in them, in the midst of caseous nodules, one could see many spermatozoa. Simmonds<sup>54</sup> has seen spermatozoa, often in large



FIG. 223.—Longitudinal section of testical and epididymis. Tuberculosis chiefly of the upper pole of the latter. Large tuberculous nodule in upper pole of testicle in the body of Highmore, the favorite seat of testicular tuberculosis. (Specimen from Warren Museum.)



FIG. 224.—Longitudinal section of testicle and epididymis showing compression of the testicle by extensive tuberculous involvement of the lower pole of the epididymis. (Specimen from Warren Museum.)

numbers, in an extensively destroyed testicle. Baumgarten<sup>10</sup> observed that while the tubules were more and more compressed and squeezed together by the development of inflammatory connective tissue and infiltration, the epithelium itself still persisted and spermatogenesis was carried on by active karyokinesis.

The macroscopic appearances of the testicle when removed at operation may show an organ studded with miliary tubercles or it may present a caseous or necrotic focus near its junction with the epididymis (Fig. 222). All observers agree that the testicular invasion generally begins at the body of Highmore (Fig. 223), whence it spreads to other parts. In certain cases, even with a long-standing and extensive

tuberculosis of the epididymis, the testicular tissue remains intact and will be found compressed by the slowly enlarging epididymis, as shown in Fig. 224. It not infrequently happens that a small and centrally located tuberculous process in the testicle will give no external sign of its presence. For this reason exploratory orchidotomy is to be recommended in doubtful cases. Yet in spite of careful macroscopic examination our experience has shown that 66 per cent. of the testicles associated with tuberculous epididymes and removed showed microscopic evidence of tuberculosis.

Before leaving the pathology of epididymis and testicle it may be observed that an actively tuberculous process of the tunica vaginalis is occasionally found. The serous coat is deeply injected, there are innumerable tiny ecchymoses, and small tubercles may dot its surface or that of the epididymis. In practically every case more or less hydrocele fluid escapes when the sac is opened, and its walls are adherent to a greater or less extent, especially at the lower pole.

*The pathology of the tuberculous prostate* has been given much study. Experimental infections naturally show the earliest stages better than clinical specimens, especially as the latter are seen at autopsy when the disease is well advanced. The first changes begin just under the epithelial layer of the ducts. George Walker<sup>70</sup> says of the subsequent changes:

"After the formation of a considerable subepithelial aggregation, the epithelium becomes invaded by the adventitious cells and the lumina of the ducts are encroached upon; later the lumina are filled with a mass of cells in which one can distinguish a large number of epithelioid, degenerated epithelial, small mononuclear cells, and polymorphonuclear leukocytes. Very soon after this stage, or in fact along with it, one sees a number of degenerated and dead cells; the nuclei are fragmented, and the protoplasm is granular and cloudy. As this advances, the cells are converted into a granular mass without any definite cellular differentiation. In the ducts the epithelial lining disappears, leaving the walls made up solely of connective tissue. The prostate is converted into a number of cheesy, rod-like masses, interspersed among which is the connective and muscular tissue of the gland. This later breaks down and the whole gland is converted into tuberculous tissue."

Hallé and Motz,<sup>25</sup> with a large experience at the Necker Hospital, divide the tuberculous changes of the prostate into

1. Small, primary tubercles.
2. Large tubercles, which may present macroscopically a stage of softening, a stage of encystment, and a stage of fibrous induration.
3. Encysted tuberculous abscesses.
4. Tuberculous cavities, partly or wholly open.
5. A special form of massive infiltration, caseous or necrotic.

The latter type seems to predominate. Careful pathological study shows that the tubercles are especially abundant in the middle lobe, but in more than half both lobes are attacked. Unilateral lesions are distributed without marked predilection for one or the other side. According to Reclus<sup>52</sup> and to Simmonds,<sup>25</sup> the early lesions are often

unilateral in the lobe corresponding to the diseased epididymis. Anatomical facts do not clearly confirm this, but in the early stages it is hard to confirm.

Cholzoff<sup>16</sup> says that tuberculosis of the prostate occurs in the form of cheesy, degenerated tubercles of different size and rarely the whole organ shows homogeneous, cheesy degeneration. Involution of the disease he regards as rare.

Götzl<sup>22</sup> thinks the tuberculous prostate rarely, if ever, becomes encapsulated and calcified.

Hesse<sup>26</sup> classifies the changes in the prostate thus:

1. The stage of tubercle formation.
2. The stage of confluence of tubercles.
  - (a) Caseation.
  - (b) Abscess formation.
3. The encroachment upon
  - (a) The periprostatic tissues.
  - (b) The whole organism, as an acute miliary tuberculosis.
4. The stage of healing.

Albarran<sup>1</sup> recognized:

1. Nodular infiltration.
2. The cavernous type.
3. The degenerative form.
4. Prostatitis with periprostatis.

Many investigators, Hesse,<sup>26</sup> Lowenstein<sup>45</sup> and others, recognize a bacillary catarrh of the prostate as one of the earliest changes of tuberculosis. Macroscopically, there is nothing to be seen, and even the microscope may find but little alteration. The prostatic secretion, however, is loaded with virulent tubercle bacilli.

*Tuberculosis of the Seminal Vesicles.*—For a good description of the tuberculous seminal vesicles we are again indebted to George Walker,<sup>70</sup> whose experimental investigations have been most thorough. The earliest specimen he found was five days after inoculation. There is at first a diffuse injection of the mucosa with a few pin-point tubercles. These gradually enlarge to pin-head size in about twelve days. They fuse and finally cover the whole mucosa, on which there are tiny ulcers. Later, there appears an exudate of a tough, fibrous, necrotic mass. This replaces the mucosa, and fills the lumen with semisolid grayish-yellow material. The walls become invaded and much thickened, and composed almost entirely of tuberculous tissue. In the advanced stages there is an extensive, adhesive, perivesicular tuberculous process. In a few vesicles there were discrete, fair-sized tubercles here and there, with almost normal mucosa between.

Microscopically the disease is seen to begin just under the epithelium. There is a small aggregation of epithelioid cells together with a few small, round cells; leukocytes are added to these and there is finally formed a small olive-shaped mass of cells which raise the epithelium, and shortly invade it. Sometimes there is an early invasion of the epithelium from the tissues below, and the tubercles appear to be formed

in the epithelial layer. In other cases the tuberculous process pushes directly upward, invading the epithelial structures and protruding above the surface; there is no epithelial cap, and the whole of the minute papule is composed of tuberculous tissue. As the tuberculous process invades the epithelial layer, a break occurs in the surface and an ulcer is formed. This gives rise to fibrinous yellowish exudate which often covers the whole surface with a thick, diphtheroid membrane. The whole epithelium disappears and the membrane rests directly on the submucous tissues. In advanced cases the walls are thickened with caseous infiltration, and widespread destruction of muscle and fibrous tissue occurs. The process extends to the outside and involves the fascial covering.

This invasion of the perivesicular and of the periprostatic tissues is especially important. As I shall point out later, it not only makes the removal of these organs difficult, or impossible, but it also makes the complete ablation of the disease a futile effort. As seen at operation or autopsy, the entire vesicle is generally found to be invaded by the disease, and in most cases both organs are involved.

Although many authors do not recognize the possibility of the subsidence of a tuberculous infection of the prostate and vesicles, such an event frequently takes place. My observations extending over a number of years show a marked cessation in the activity of the infection of these organs (amounting to a clinical cure) after removal of the epididymes. Herein lies one of the strongest arguments of those of us who regard the epididymis as the primary focus of genital tuberculosis. Also Lapeyre<sup>42</sup> has noted the tendency of the prostate to become encysted in fibrous tissue or to take on fibro-adipose changes. He found 19 such cures in 36 autopsies.

The condition of the vas deferens varies much. For a certain length of time it may show no tuberculosis at any point. Later the epididymal end becomes involved, the pathological changes gradually tapering off and finally disappearing as the inguinal canal is reached. Involvement of the entire vas from epididymis to prostate is evidently rare, if indeed it occurs at all. This statement is based upon many observations of my own and those of K. M. Walker and Hawes,<sup>72</sup> and of Lapeyre.<sup>42</sup> The former, believing that the prostate is the primary focus of genital tuberculosis, have shown that the infection spreads centrifugally from the prostate along the lymphatics of the vas. Whether this also occurs in secondary tuberculosis of the prostate I am unable to say, but I see nothing against it. At any rate, we have the fact of a high percentage of azoöspemia, even with a unilateral process, indicating pathological changes in, and obstruction of, the vasa.

K. M. Walker and Hawes<sup>72</sup> have shown that near the epididymis and for a certain distance beyond, sections of the vas show a ring of caseous material in the mucous lining, while the outer coats are intact. Farther up there may be no evidence of disease at all, while sections near the prostate will show infiltration, not in the mucous coat, but in the adventitia and more particularly in the lymphatics surrounding it.

In well-developed cases the vas, especially its scrotal portion, may present numerous and fairly regular fusiform swellings along its course, resembling a chain of beads. The surrounding tissues and other elements of the spermatic cord are stiffened and adherent, sometimes embedded in dense scar tissue.

Microscopically, according to George Walker,<sup>70</sup> the initial process "begins just underneath the mucosa and extends upward, invading, and finally completely replacing, the epithelium. In this manner the whole of the epithelial layer is disintegrated and separated from the underlying tissues. The lumen then becomes filled with tuberculous debris, similar to that seen in the prostatic tubules and the ducts of the epididymis."

*Tuberculosis of the urethra* has been shown to be rare clinically, but it has been produced experimentally by a number of investigators. George Walker's<sup>70</sup> experimental work showed three stages of the disease:

1. Very minute tubercles.
2. Larger tubercles and ulceration.
3. Caseous infiltration.

As in all other tuberculous infections of the genital tract, the microscope shows the disease to begin "just beneath the epithelium, where there is seen a small cellular aggregation, which later invades the overlying epithelium and forms the minute tubercle which can be seen with the naked eye; an erosion of the epithelium soon occurs, and a tiny ulcer is formed. The organisms at the same time invade the submucous tissues, and finally the deeper tissues, with the formation of caseous infiltration more or less widespread."

The organisms do not seem to invade the mucosa directly, but it seems probable that the bacilli penetrate between the epithelial cells and lodge immediately under them. While trauma is certainly a predisposing factor, it does not seem to be essential in the production of stricture.

*Tuberculosis of the Glans Penis.*—I have already shown that tuberculosis of the glans penis is occasionally seen, infection at the time of circumcision, and, as some believe, coitus, furnishing most examples. The disease takes the form of a chronic ulcer, as to the etiology of which all other organisms must be excluded. The microscope will reveal the nature of the lesion.

A picture of the widespread havoc produced by the disease, once it has gotten outside of the genito-urinary tract, was presented by three of our patients who died of a general miliary tuberculosis following operation.

In one, a boy aged six years, with a unilateral process of two months' duration, practically every organ outside the genito-urinary tract was studded with miliary tubercles. The excised specimen showed tuberculosis of the epididymis (there was no note on the testicle), but strangely enough bladder, prostate, seminal vesicles, and the remaining testis and epididymis showed no evidences of infection. There was a history in this case of an early tuberculosis of lung and meninges, and its remains were found at autopsy.

The second case, aged thirty-five years, had a more or less active process in the spine, of six years' duration. The epididymitis was right-sided, and of unknown age. Autopsy showed old tuberculosis of right kidney and ureter, bladder, pleura, peritoneum, bronchial lymph glands, spine, seminal vesicles, and prostate, with abscesses in the latter. Both testicles, and the remaining epididymis were healthy. A cover-glass preparation of the seminal fluid showed no tubercle bacilli.

Our third case occurred in a man, aged twenty years. The process was again right-sided, its duration was said to be only a few days, and the pathologist reported an infection of testicle as well as of epididymis. Autopsy showed a general miliary tuberculosis, including the meninges. The bladder was uninfected, as well as the left seminal vesicle, and the left testicle and epididymis. But the prostate and right seminal vesical contained abscesses and caseous foci.

It must be clear from this discussion of the pathogenesis and pathology of genital tuberculosis that many points are unsettled entirely, or are much in dispute. This ignorance and lack of agreement is due, not so much to a paucity of single or brief observations, clinical or experimental, as to a failure to study all the available material from beginning to end. The situation is well summed up by Hallé and Motz.<sup>25</sup> They say:

"A detailed mass of statistics, patiently followed up, on pulmonary tuberculosis on the one hand, and on genito-urinary tuberculosis on the other, from the earliest clinical symptoms to the ultimate issue, will furnish sufficient and certain conclusions. We do not yet possess such a mass of statistics."

**Etiology.**—Although the tubercle bacillus is the organism responsible for the disease in question, certain conditions for its growth must generally be fulfilled before it can gain a foothold in the genital tract. These are:

1. A lowered resistance on the part of the patient.
2. A previously existing tuberculosis of some other part of the body.
3. A lowered resistance on the part of the particular organ or organs attacked.

The first condition may be assumed to exist in any individual acquiring tuberculosis.

The second condition I have shown to be fulfilled in a very large percentage of cases.

While a lowered resistance on the part of the organ first attacked cannot always be demonstrated, certain contributing factors can be shown to exist, or to have recently existed, in a considerable number of cases.

First let us consider trauma. Tyliniski<sup>66</sup> and others have shown conclusively, in animals, that this has a distinct influence upon the localization of a tuberculous process in an organ. In our material a definite history of injury to the infected organ was obtained in 18 out of a possible 92 cases. In tuberculosis elsewhere, bone for example, the outbreak of the disease is very frequently preceded by an injury.

Second, infections of the epididymis or other organs, generally gonorrheal, may be a predisposing cause in certain instances. Out of 95 cases, of the series just mentioned, 34 (35 per cent.) had had an infection of the epididymis in the course of an attack of gonorrhea. A study of additional material has shown about the same percentage. Whether the initial epididymitis was of gonorrheal or tuberculous origin is hard to say.

Under exciting causes we should include ectopia of the testicle. This in itself may lower the vitality of the organ or subject it to trauma. Ferron<sup>21</sup> and Le Dentu<sup>43</sup> have reported cases of tuberculosis of such an organ.

Tuberculosis of the genital tract may attack the infant or the old man. One of my patients was eighteen months old; another was a man of seventy-three. Of 201 cases of genital tuberculosis collected by Hesse,<sup>26</sup> 2 occurred before the tenth year, 1 between seventy and eighty, and 1 after the eightieth year. Between the twentieth and fortieth years he found 118, or 58.7 per cent., and from forty to sixty years 49, or 24.3 per cent.; in other words, 83 per cent. were between twenty and sixty years old. In 120 patients (all with tuberculosis of one or both epididymes) I found 45 per cent. between the twenty-fifth and thirty-fifth years. Sixty-five of 96 cases reported by Keyes<sup>33</sup> were between twenty and forty years old. Vignard and Thévenot<sup>68</sup> have collected several cases of epididymal tuberculosis in infants. Two of their own patients were respectively fourteen months and eleven months old, each with a unilateral process. These authors cite a case in a patient of Cholmeley's<sup>63</sup> six months old; 1 of Hochsinger's<sup>63</sup> thirteen months old; 2 of Swoboda's<sup>68</sup> which were "nursing;" 4 of Launois's<sup>68</sup> ranging in age from six to thirteen months; and 12 cases of Julien's<sup>68</sup> in patients under two years of age. No mention is made of the condition of the prostate or vesicles in any of them. I have found 1 case, reported by Davids,<sup>18</sup> in a man eighty-five years old.

I have already indicated the frequency with which secondary tuberculosis of the prostate and vesicles is found, but these figures apply chiefly to adults. All authors agree that before the age of puberty these organs are rarely attacked. Thus Kantorowicz,<sup>31</sup> in 57 cases of epididymal tuberculosis in children, found the prostate involved but twice. In the cases under twelve to fourteen years of age (6 in all) coming under my own observation, I have seen no prostatic or vesicular tuberculosis. The combined experience of all observers shows that prostatic and vesicular tuberculosis is most frequent during the time of the greatest activity of these organs, *i. e.*, from about the twentieth to the fortieth years.

No statistics which I have seen give the incidence of marriage. Among our cases 66 per cent. were married. Not that this is strange, for matrimony usually claims this number. But as it has been stated that the disease may be conveyed by coitus, I note that in not one of this number was there anything to suggest that marital relations were the cause of contagion.

The etiological factors already enumerated for tuberculosis of the epididymis, will apply as well to that of any organ of the genital tract, whether primarily or secondarily involved.

**Clinical Signs and Symptoms.**—The clinical picture of tuberculosis of the epididymis which I present, is based upon several studies of a group of cases from the Massachusetts General Hospital. They offer for consideration 210 tuberculous epididymes.

*Duration of the Disease.*—Fifty-three per cent. of the patients noted the presence of the disease within the six months preceding their appearance at the hospital; in a few it was a matter of only days or weeks. In 72 per cent. the infection had begun within the previous year. Thence the time lengthens until from five to eight years have elapsed since the process began, and during which the smoldering fire has more than once broken into flame, only to be quenched with a poultice or a bag of ice. Moreover, nearly half of the patients acknowledged having submitted to more or less minor surgery in a vain effort to stamp out the disease. This interference was usually the tapping, often repeatedly, of a hydrocele, which so frequently accompanies the tuberculous process. In a larger number than one would like to see, the family doctor had merely lanced the abscess, thus prematurely giving birth to the sinus which is so common.

I would call attention to the fact that owing to the insidious nature of the disease, the patient can give, in most cases, no accurate answer as to the duration of his trouble. In this respect it is strikingly different from the epididymitis of gonorrhea, with its sudden onslaught. In a few instances the tuberculous process is ushered in with severe pain, tenderness and swelling, but even then one cannot be sure that the disease has not been going on for some time unknown to the patient.

*Side Involved.*—The right side was affected in 59 (39.3 per cent.), the left side in 47 (31.3 per cent.), and both sides (at time of entrance) in 44 (29.3 per cent.). Sixteen patients (10.6 per cent.), after operation upon the first side, subsequently returned with tuberculosis of the second epididymis. There was, therefore, a total of 60 (40 per cent.) with bilateral disease, but it will be seen that the number of relapses was far less where the first epididymis had been previously removed.

Keyes<sup>33</sup> in a series of 87 cases has found a relapse upon the second side in 53 (60.9 per cent.).

König<sup>36</sup> noted bilaterality in 75 per cent., while Beck<sup>30</sup> puts it at 27 per cent. v. Bruns<sup>69</sup> found both sides involved in 38 per cent., while in 111 cases from the Tübingen Clinic the percentage was 29. Thus the chances of escape of the second epididymis are seen to be slim, but the management of the first epididymis seems to influence the fate of its fellow. Keyes<sup>33</sup> says: "Be the operation ever so slight or ever so radical" relapse upon the opposite side almost inevitably occurs. My figures show that relapse is less apt to occur if the first epididymis is operated upon.

*Time of Involvement of the Second Epididymis.*—The time of involvement of the second epididymis, after the infection of the first side,

varies considerably, but is usually not long delayed. In my series this point was ascertained in 49 patients. In 26.5 per cent. it took place within six months, while in the first twelve months 38.7 per cent. were so affected. In the remaining 44.8 per cent. the number of relapses dropped steadily after the first year, but took place in a few cases as late as the eighth year. Keyes<sup>33</sup> cases show that 46 out of 53 infections of the second side occurred within the first year.

Eight of my cases (16.3 per cent.) experienced an apparently simultaneous infection of both epididymes, ranging in duration from a few weeks to eight years before the patient sought relief.

It is therefore clear that the damage to the second side is an early event in most cases, but the danger is not entirely eliminated until after the lapse of at least eight years. It is also quite possible that the infection of the second epididymis may be so slight as to be overlooked at the time of operation upon the first side. This possibility is to be considered in one's statement to the patient of the condition and outlook of the second epididymis.

*Results of the Disease.*—I have found that over 80 per cent. of those questioned on the subject have lost weight. In some, the depletion of flesh and strength was extreme, sometimes without demonstrable tuberculosis other than that in the genital tract. Per contra, a few individuals had put on weight and appeared to be in the "pink" of condition.

*Pain.*—This was noted in about 60 per cent. of my cases. It was usually mild, often trifling. Generally speaking, it was located in the diseased organ, but in certain instances was said to have extended upward to the groin or even into the lumbar region. Radiation upward was usually the result of more or less extensive involvement of the vas deferens and other structures of the spermatic cord. More often than not its presence in the scrotum could be accounted for by the pressure of hydrocele fluid upon an acutely inflamed epididymis or testicle. In spite of the high percentage of tuberculous prostates and vesicles, I have noted practically no pain located in these organs or their vicinity. Pain in the region of the bladder may, however, be experienced during, or at the end of micturition, and is found in cases of bladder tuberculosis of renal or prostatic origin.

During one of the characteristic exacerbations of the disease, scrotal pain may be intense, abating with the rupture of an abscess and the establishment of fistula, or by absorption of its products. Before such an outbreak of the disease there may be no pain at all.

As an accompaniment there may be tenderness, not intense, barring always the very acute cases, but, generally speaking, of only a moderate degree, its intensity doubtless regulated by the same factors which produce pain.

*Fistula.*—This is one of the most common "earmarks" of tuberculosis of the epididymis, and is generally to be found in the skin at, or near, the lower pole of the organ. Fistulae at the upper pole are seen occasionally.

Seventy-seven and three-tenths per cent. of 106 cases in my series had one or more fistulae in the scrotum. More often than not they were active; in others they showed a volcanic intermittency. The discharge is profuse at times, and is thin, purulent, and yellowish in color.

In 22.6 per cent. of these 106 patients the scrotal skin was more or less adherent to the epididymis and in some cases marked the site of an ancient fistula, long since inactive.

That fistulization is an early event is shown by an examination of the 82 patients in this series presenting this condition. In exactly 50 per cent. the abscess had formed, ruptured and established a fistula within six months after the onset of the disease, while within the first year this had taken place in 71 per cent. of the 82 cases. The progress of the disease is, therefore, not slow in most instances, but on the other hand, I have seen several epididymes, tuberculous for eight or nine years, with a fistula of only a few days' duration.

*Fever.*—An elevation of temperature before operation was noted in but 10 cases, the epididymes in these being in a state of acute inflammation.

*Condition of Prostate and Seminal Vesicles.*—Owing to the proximity of these organs one to another, and to their close relationship, I believe that when the prostate is tuberculous, the seminal vesicles are also involved, or that they may be so regarded for clinical purposes.

The effect of the disease upon these organs has already been dwelt upon at some length and I have shown that 76 of 101 rectal examinations in my series of cases revealed tuberculosis of the prostate and seminal vesicles.

A more detailed study of these cases has shown that where prostate and vesicles were regarded as tuberculous, epididymitis was unilateral in 38 and bilateral in 38; while in the negative cases one epididymis was tuberculous in 16, and both were involved in 9. From which it follows that prostate and seminal vesicles become readily involved in the presence of one tuberculous epididymis, and before infection of the opposite side has had time to take place. In substantiation of this point I have data as to the condition of the prostate and vesicles and the known duration of the epididymal infection in 99 cases. In the first six months of the disease prostate and vesicles were found to be infected in 40 and healthy in 15; in the period from six months to one year 14 were positive and 3 negative. After the first year, and, in some cases, after a period of six or seven years, prostate and vesicles were tuberculous in 20 and negative in 7. Thus in the first six months of the disease 30 per cent. are infected, and in the first year 54 per cent. On the other hand, one must not lose sight of the 7 prostates which are said to have held the enemy at bay for periods ranging all the way from one to six or seven years.

*Bladder Symptoms and Condition of the Urine.*—With so frequent and early an infection of prostate and vesicles, the bladder neck becomes irritable at an early date. In 45 patients (35 per cent.) urinary symptoms such as frequency, dysuria, and urgency were recorded, while

43 per cent. of 104 urines contained pus, blood and albumin. Also, out of 10 urines with which the guinea-pig was inoculated, 8 showed the presence of the tubercle bacillus. As in the absence of symptoms pointing to the kidney, cystoscopy and ureteral catheterization have seemed to us to be unwise, it is barely possible that some of these tuberculous urines were of renal origin. In this series there were recognized and operated upon, 18 cases of renal tuberculosis, occurring at some time or other in the course of the epididymitis. The 8 tuberculous urines already referred to include none of these cases. It is probable, therefore, that the pathological urine and the bladder symptoms took origin from the prostate. This belief is substantiated by the observations of Lowenstein<sup>45</sup> who, in 18 cases of epididymal tuberculosis, found tubercle bacilli in the urines of all. Renal tuberculosis was excluded as the source in every case and the prostate was regarded as accountable for the bacilli.

Accompanying the bladder symptoms and the pathological urines in this series, prostate and vesicles were recorded as tuberculous in 28 and negative in 4. Furthermore, the relation of bladder irritability to the known existence of the epididymitis has been looked into in 43 cases. In 21, or 49 per cent., urinary symptoms were present in the first six months of the disease, whereas, in the first year the figures jump to 27, or 62 per cent.

*Condition of the Testicle.*—Sixty-six of the testicles in this series were found to be tuberculous. Forty-four occurred in unilateral cases, and only 22 where the process was bilateral. In other words, testicular infection is generally found in the early months of the epididymitis. Thus 60.6 per cent. of the total number had become tuberculous in the first six months of the disease, and 83.3 per cent. in the first year. That the testicle may resist invasion for a long period of time is illustrated by several cases in which the epididymal disease had existed for from five to eight years. These observations differ from those of Haas<sup>24</sup> and Lapeyre<sup>42</sup> who found the percentage of infected testicles to be progressively greater with the age of the epididymitis.

*Condition of the Vas Deferens.*—It is unfortunate that physical examination often overlooks an important and an interesting feature of a case. This has been true with the vas deferens. I have notes as to its condition (mostly macroscopic) in 46 instances, 26 of these being on the side last involved. Of the latter, 16 (61.5 per cent.) were thickened for a greater or less distance upward from the epididymis, in some instances this being extreme. Fifteen out of 20 vasa (75 per cent.) of the first epididymis to be involved were regarded as tuberculous.

While these figures are insufficient for accurate deduction, the fact that the vas of the epididymis last involved is less often diseased than is its fellow, would indicate that the tubercle bacillus reached the second side by the blood stream, or by the lymphatics.

*Sex Function.*—I have mentioned elsewhere that 85 per cent. of the patients whose semen has been examined have shown azoöspemia, even with only one epididymis involved, an observation supported by

the experience of Keyes.<sup>33</sup> Further studies confirm this view. This condition is probably accounted for by an obstruction of the vasa deferentia, that on the still healthy side being doubtless involved at its urethral extremity by extension of the disease from the prostate.

Masculinity does not seem to be impaired even after double orchidectomy. Several of our cases bear out this statement, and Simon<sup>60</sup> says the sex function remained normal for from ten to twenty years in 29 of his cases of double orchidectomy for tuberculosis. It has also been shown that spermatogenesis is persistent, even in a testicle riddled with tuberculosis.

The symptomatology of primary prostatic tuberculosis is little different from that which is secondary to epididymal disease. The bladder irritability, the character of the urine and the course of the disease present no striking differences.

Difficulty of urination, or possibly retention, plus the evidences of tuberculosis, would characterize a tuberculous stricture of the urethra. It has been my experience to find this lesion accompanying renal tuberculosis.

A chronic ulcer of the glans penis, not associated with venereal disease, might lead one to suspect tuberculosis. Microscopic examination would confirm the suspicion.

**Diagnosis.**—The diagnosis of a typical case of tuberculosis of the epididymis is not difficult. Induration, enlargement, and nodularity of the organ, especially at its lower pole, associated with little or no pain or tenderness, is the usual clinical picture. If, in addition, one finds the corresponding vas deferens enlarged and irregularly thickened, especially at its epididymal end, and if the prostate and the seminal vesicles (particularly on the same side as the diseased epididymis) are likewise affected, the case is undoubtedly one of tuberculosis. The chronicity of the disease, or its bilaterality would help to confirm this diagnosis. If, also, there is bladder irritability and a hazy urine containing pus and tubercle bacilli, all doubt is removed. The diagnosis is equally certain in the presence of an active fistula or the dimpled scar of one long healed.

At other times the diagnosis must be in doubt until one or more of the features enumerated above comes to the rescue, or until removal of the epididymis and microscopic examination reveals the truth. The acute tuberculous epididymis may well be mistaken for that of gonorrhea or a pyogenic infection. Only a careful history, painstaking examination, and adequate observation will solve the problem.

But it should not be forgotten that an attack of gonorrhea which has escaped the patient's memory, an unobserved syphilitic infection of long ago, an infection of the epididymis in the course of a colon bacillus cystitis, or with a pyogenic organism from some septic focus elsewhere in the body, may each produce a picture not unlike that of tuberculosis.

One can never be certain of the condition of the testicle. An increase in the size of the organ, with nodularity of its surface, may mean disease, or may signify only an invasion of the overlying tunica.

If the evidence is in favor of tuberculosis, or if the disease is clearly

progressing, an exploratory operation should be advised. The diagnosis of lesions within the scrotum are so uncertain, even when made by the most expert, that the patient should be given the benefit of the doubt. If he has tuberculosis he is entitled to the earliest treatment; if he has not tuberculosis he is entitled to the joy which that knowledge brings.

**Prognosis.\***—I have already pointed out the disastrous results of genital tuberculosis and their rapidity of occurrence. It has been shown that the second epididymis is attacked in 26.5 per cent. within the first six months after the involvement of the first side; that the disease invades prostate and vesicles in 30 per cent. within the same time; and that testicular tuberculosis within this period is found in 60.6 per cent. If one adds to these misfortunes the annoyance of bladder irritability, and the affliction of sterility, the outlook is indeed gloomy. It is also to be remembered that a very large proportion of patients have the proverbial axe hanging over them in the form of tuberculosis of other organs.

Let us now see what encouragement can be held out to the patient with tuberculosis of the epididymis. I have traced 113 patients from one to twenty-five years after operation. Over 27 per cent. have died of some form of tuberculosis. Within a period of six years after operation 41 per cent. of 58 patients have died of this disease. Of the deaths from tuberculosis, 14.2 per cent. occurred within one month, 32.1 per cent. within six months, and 50 per cent. within one year after operation. During the first six years 85 per cent. died, while between the ninth and eleventh years 10.7 per cent. succumbed. Miliary, renal and lung tuberculosis were, in order, the final types of the disease. A large majority of those dying of tuberculosis had had one or more outbreaks of the disease both before and after operation. My experience warrants the conclusion that until at least ten years have elapsed after operation, no patient can be said to be cured of genital tuberculosis. The high percentage (14.2) of the total deaths from tuberculosis within a month after operation, in the hospital, deserves a word of explanation. There were actually four deaths within this period, giving an operative mortality of 2.66 per cent. for the total number of 150 cases. Operation was performed in all under ether, an anesthetic which is generally recognized as likely to stir up an otherwise quiescent focus of tuberculosis in the lung. I am convinced that the employment of a local anesthetic (novocain) or of gas-oxygen anesthesia, as is at present usually done, will eventually reduce this high operative mortality.

The records of the 60 patients now living (53 per cent.) show a much smaller percentage of other tuberculous processes before operation than do those of the dead, but many of them have since developed other foci. As 81 per cent. of those examined and 28.5 per cent. of those reached only by letter are still within the six-year period, in which I found that 85 per cent. of deaths occurred, it is to be expected that the

\* For the views here expressed I shall quote freely from my paper on "The Ultimate Results of Genital Tuberculosis in the Male."<sup>6</sup>

deaths from tuberculosis in this group are not yet at an end. The long life and good general condition of many of the patients, even though suffering from repeated outbreaks of the disease, shows that the survival of the patient depends largely upon his ability to immunize himself to the disease. Taken all in all, the odds are against the patient. The longer he can live and fight down any particular outburst of the disease the better able he is, in most instances, to overcome the next exacerbation.

The facts here presented are somewhat different from those of other writers. Lapeyre<sup>42</sup> says that 75 per cent. of his cases are cured, and that a survival of the patients of from four to ten years after operation is to be expected.

Simon<sup>69</sup> has followed 92 cases from the Heidelberg Clinic. Fifty-four were found to be alive and free from tuberculosis, but this disease had claimed 26 of the 33 who had died. Lung tuberculosis figured largely in the latter, and was frequently found in those still alive.

v. Bruns<sup>69</sup> found bilateral epididymal tuberculosis in 38 per cent. of his cases. Of those having operation on one side, 23 per cent. returned within three years for the removal of the second testicle. Of the single castrations, 12 per cent. died of urogenital tuberculosis, and 15 per cent. died of tuberculosis of other organs, especially the lungs. Forty-six per cent. of the unilateral cases were cured after three to thirty-four years.

Of the double castrations, 15 per cent. died of urogenital tuberculosis, and 25 per cent. of tuberculosis of other organs, the lungs again being most often attacked. Fifty-six per cent. of this group were cured after three to thirty years.

Berger<sup>12</sup> has reported 60.4 per cent. of cures after single or double castration, but does not state the time elapsing after operation.

Among the cases analyzed here, epididymectomy, partial or complete, single or double, was performed 78 times. I have stated elsewhere on several occasions, as evidence of the efficacy of this operation, that not one of these patients had been obliged to submit to subsequent orchidectomy. This record is now broken by 2 cases, from whom it was deemed necessary to remove the testicle within one month and two months respectively after epididymectomy. The pathologist reported tuberculosis of one gland; the other showed only a round-cell infiltration, and its removal was clearly an error of surgical judgment. At the first operation there was no evidence in either case that the testicle was diseased. What better proof is there of the efficacy of epididymectomy, even though we know that in certain of them a more or less infected testicle was allowed to remain?

I find that this experience agrees with that of Lapeyre,<sup>42</sup> Keyes<sup>33</sup> and Marinesco,<sup>46</sup> although the latter has had 6 of his unilateral epididymectomies return within two months for a secondary castration. The size, shape, consistency, and, in most cases, the sensation of the testicle are unaffected, and the benefit to the patient morally and physically is well worth the very slight chance of the necessity of a secondary orchi-

dectomy. I think we are apt to regard altogether too lightly the great value of the internal secretion of the testicle.

In this connection it may be mentioned that a tuberculous tunica vaginalis may assume an unexpected activity after epididymectomy. The clinical picture is very like that of an orchitis, and in this belief orchidectomy may be advised or even done. There have been 3 such in my series, but in each a careful investigation of the situation, and the free use of the curette has saved the testicle.

The very great incidence of sterility, even with unilateral epididymal tuberculosis, has been pointed out. I have no evidence that this condition is done away with, in spite of an otherwise successful issue of the case. An involvement of one or both testicles does not seem to affect potency, and this may continue even after bilateral orchidectomy.

Postoperative sinuses of the groin or scrotum are now a negligible factor in our experience. If the vas is divided in the region of the external ring, where it has been shown to be tuberculous in many cases, a sinus of several weeks' or months' duration is not unusual. By dividing the vas well over the pelvic brim, at a point where, with few exceptions, it is free from disease, no sinus will occur. Since the introduction of the technic of epididymovasectomy, to be described later, I know of no case in which even a temporary sinus from the stump of the vas has occurred. In a few instances there have been small and short-lived sinuses of the scrotum, but they have readily yielded to time, tuberculin and hygiene.

In 69 of the 113 patients whom I have followed, the prostate and seminal vesicles were found to be tuberculous at the time of entrance to the hospital. I have since examined many of them at various intervals of time after operation. In most instances the induration, nodularity, and tenderness, present before operation, has subsequently disappeared entirely or much decreased. In a few, the condition is the same as before operation. In 2 instances an abscess subsequently formed and opened spontaneously, with the establishment of a perineal fistula, from which urine has leaked at times.

The tuberculous stricture has a habit of closing down rapidly after dilatation or division, much more than is the case with one of gonorrheal origin.

The facts here presented are based upon operated cases. They demonstrate beyond question that, taken all in all, the odds are against the patient.

I have but few data of patients who have had no operative treatment. There were eleven such cases in the material that I have studied, which were not operated upon for one reason or another. None, so far as I am aware, were given tuberculin or any special hygienic care. Six died from tuberculosis, 1 three months later, another after ten years; 1 was "well" a year later; 1 died of "apoplexy" shortly after; 3 cannot be traced. While these figures are too small to be of much value, they show that the outcome was not brilliant. Keyes<sup>33</sup> found 30 per cent. of "cures" in 34 cases without operation and watched for more than

three years. He says, "They would not be verified if the cases were more numerous," and I am inclined to agree with him.

While we have a high opinion of tuberculin as an adjunct to the postoperative care of genital tuberculosis, we have advised strongly against it as a substitute for operation. Some of the French writers, on the other hand, have much to say in its favor in the expectant treatment of the disease. Lelongt<sup>44</sup> quotes the statistics of Mantoux, based on 70 cases of genital tuberculosis treated in this way. He thinks they are encouraging when one considers that they had no hope of improvement by surgical treatment. These cases showed cure in 33 per cent., much improvement in 48 per cent., no change in 11 per cent., and deaths in 8 per cent.

No details are given, especially of the time during which the cases were observed. Without definite facts one hesitates to accept the claims.

**Treatment.**—This may be divided into expectant, conservative, and radical, tuberculin being an important adjunct throughout.

Expectant treatment should be undertaken only in those cases where operative measures are refused or, for some reason, impossible. It means putting the patient under the very best of hygienic conditions as regards fresh air, sunlight, food, work and sleep. Tuberculin should be given regularly and intelligently. It means the tapping, when indicated, of the hydrocele which so often accompanies the tuberculous epididymis, and, to those who have a pathological urine or bladder symptoms, sandalwood oil should be administered (10 minims thrice daily).<sup>\*</sup> If abscesses of the scrotum occur they should be incised and properly drained.

By conservative treatment I refer to the removal of the epididymis, together with as much of the vas as is easily accessible, and, where necessary, the testicle.

The history of operations upon the epididymis has been written by Marinesco.<sup>46</sup> Recognizing the evil effects, mental and physical, of castration, especially when bilateral, and acknowledging the importance of the epididymis in genital tuberculosis, Berard,<sup>46</sup> in 1834, performed the first partial epididymectomy. In 1851 Malgaigne,<sup>46</sup> as well as Jobert<sup>46</sup> and de Lamballe,<sup>46</sup> were performing a complete and extensive excision of the epididymis. Bardenheuer,<sup>46</sup> in 1880, is credited with the first real description of epididymectomy, and he showed its value in a series of 34 cases.

Villeneuve<sup>46</sup> did the first epididymectomy in France in 1889, and emphasized the great value of the testicle for its internal secretion, as well as for its psychic effect.

While the French surgeons were doing their utmost to preserve the testicle, the Germans, with one or two exceptions, continued their habit

<sup>\*</sup> A very efficient substitute for sandalwood oil is a capsule composed of guaiacol carbonate gr. iij, powdered pepsin (1 to 3000) gr. j, calcium carbonate (C.P.) gr. x. This is given thrice daily after meals. All preparations containing hexamethylenamin are likely to aggravate bladder symptoms.

of promiscuous castration. Unfortunately their example has been copied all too widely and even today the general surgeon, otherwise sound and conservative, removes the testicle, when by a simple operation this valuable organ can be preserved to the patient.

For the technic of epididymectomy, better called epididymovasectomy, we are indebted to Cabot,<sup>15</sup> whose description of the operation I quote. This procedure can be done in most cases with novocain local anesthesia, but in a few patients, with an acutely inflamed scrotum, or of neurotic temperament, gas-oxygen anesthesia is preferable. The use of ether is strongly condemned.

"The local preparation of the patient should involve the skin of the scrotum and the groin of the corresponding side if the disease is unilateral. An incision is made over the epididymis about two inches long. If sinuses are present they should be circumscribed by the incision. This is carried down to and opens the tunica vaginalis, which will in many cases be found adherent to the testicle and must be separated by dissection. The testicle and epididymis are delivered from the wound. The epididymis is then separated from the testicle by a scissors dissection, as in this way the vessels which lie behind the epididymis are less likely to be destroyed. The separation should be begun at the upper pole and carried downward, the epididymis being separated from within outward. When it is free, the lower inch or two of the vas should be stripped up by blunt dissection from the structures of the cord. A curved clamp is then applied to the vas and the epididymis and the lower inch or two of the vas cut away. The vas is then stripped up by blunt dissection with the fingers so as to free it from the structures of the cord up to the external inguinal ring. Guided by the finger, the clamp on the lower end of the vas is then passed up to the external ring and carefully inserted into the canal, care being taken to avoid pushing it in front of the canal between the fascia and the fat. The clamp is then pushed upward and outward, following the line of the inguinal canal until its tip lies directly beneath the fascia at the level of the internal inguinal ring. The handle of the clamp is then strongly depressed, bringing the point snugly against the skin. An incision not over half an inch in length is then made on the point of the clamp, which is then pushed out through this incision carrying with it the distal end of the vas (Fig. 225). The vas is then picked up, the traction is made so as to pull out the portion lying in the canal so that the remaining portion dives vertically into the wound and over the brim of the pelvis. The finger is then inserted into the little wound, as shown in Fig. 226, and the vas is freed as far as the finger can reach, making steady traction during this process. A right-angled clamp is then applied to the vas at the lowest accessible point. It is divided, cauterized with phenol (carbolic acid) and dropped back. The wound in the groin is closed with one catgut suture in the fascia, with a silkworm-gut stitch in the skin. The operation is completed by the careful ligation of any bleeding-points in the scrotum. Any apparent foci in the testicle are eradicated with a curette. The wound is painted with tincture of

iodin and closed with a subcuticular suture of silkworm gut, leaving a small protective-tissue drain at the lower angle. This drain has been found to shorten convalescence by giving free exit to the serum which

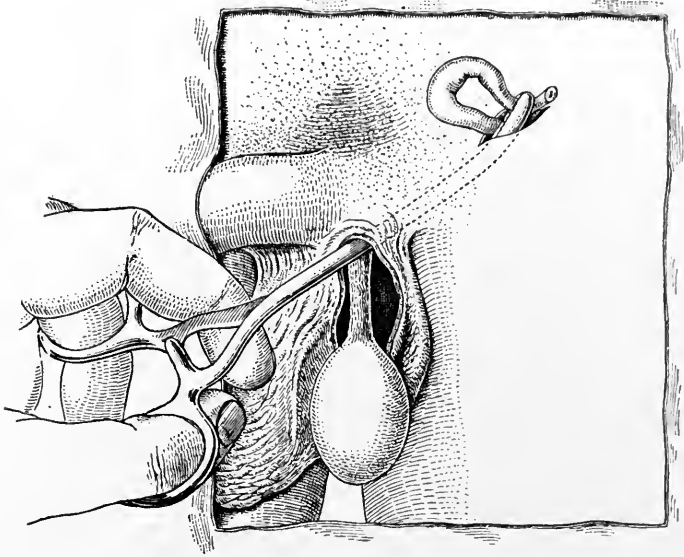


FIG. 225.—Vas held in curved clamp which has been passed up into the inguinal canal and is making its exit through a small incision opposite the internal inguinal ring.

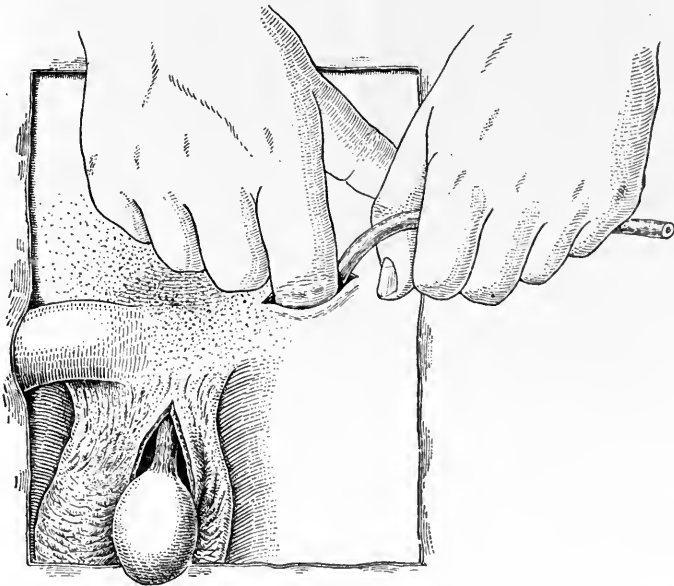


FIG. 226.—Tension is made on the vas by the operator's left hand, while with his right index finger in the inguinal incision, he frees the vas over the pelvic brim.

necessarily oozes from the raw surface, the amount of which is considerably increased by the application of iodine. The dressing is held in place by the application of an Alexander bandage, one of the many devices of the late Samuel Alexander, which has been a boon to the genito-urinary surgeon. The drain can generally be removed in forty-eight hours and the patient may be up and about in two or three days. The after-treatment should include all of the general hygienic measures suitable for patients with tuberculosis, including the routine use of tuberculin and the routine use of sandalwood oil in cases in which there is involvement of the prostate."

As regards the testicle, I would add that in suspicious cases I am in accord with Lapeyre,<sup>42</sup> that an exploratory orchidotomy, partial or complete, is not only justifiable, but harmless.

Sinuses at the point of division of the vas deferens do not occur, and those of the scrotum are insignificant and infrequent. I do not hesitate to say that this operation marks one of the most important advances in the surgery of the genital tract.

Our attitude toward the second epididymis, even though it be healthy, should be carefully considered. I said in 1911,<sup>3</sup> "knowing the life history of the disease, and finding the patient already sterile, as we shall in a very large number of cases, we feel justified in advocating the removal of both epididymes and vasa at one sitting."

While this may appear to be a radical policy, it rests upon a firm basis of surgical pathology. The beneficial effects of double section of the vas, upon vesicular and prostatic lesions has been shown by Lapeyre<sup>42</sup> and Israel.<sup>42</sup>

According to Legueu,<sup>42</sup> "in the presence of bilateral vesicular disease the second vas should be systematically ligated in the course of a unilateral operation. We then avoid at once the infection of the healthy testicle and serious involvement of the prostate." Lapeyre,<sup>42</sup> on the other hand, takes the more radical view. He has resected the healthy vas for 3 years as a routine practice and says that "after double section of the vas, as after double castration, the cure of vesiculoprostatis is more frequent than after a unilateral operation." If it is proved that the patient is already sterile, I regard this procedure as desirable.

Radical treatment involves the removal, not only of the epididymis, but also of the prostate and seminal vesicles, but we have seen no case in which this extensive operation was deemed necessary or wise. In fact, we cannot condemn too strongly this extremely radical step. White-side<sup>73</sup> is perhaps the most ardent advocate of this procedure in this country, but grants that it should be done only in "selected advanced cases." He has recently reported 22 such cases, operated on within the past six years. Four were "absolutely cured," and there has been no operative mortality. European surgeons have been more favorable to the radical operation. Ullmann,<sup>42</sup> in 1889, performed epididymo-vaso-vesiculectomy, but the operation met with little favor on account of its dangers and difficulties. Baudet<sup>7</sup> has since popularized it by making use of the inguinal route. In his hands the mor-

tality has been practically *nil*, and he has reported 46 cures, out of 58, after the lapse of from four to six years.

Interference with the prostate, either alone or in conjunction with the other genital organs, seems to be generally regarded as a serious matter and productive of bad results. Enucleation is exceedingly difficult or impossible owing to adhesions. Incision and drainage of an abscess gives only temporary relief, and is generally productive of a permanent fistula. I agree with Lapeyre<sup>42</sup> that operations upon the prostate are inadvisable; mild affections will heal after the removal of the epididymis, and extensive lesions had best be let alone. In my opinion, the same may be said of the seminal vesicle.

The treatment of tuberculous stricture of the urethra had best be conservative. Dilatation, under the influence of a local anesthetic in the urethra (a 5 per cent. solution of alypin is very satisfactory), is usually successful; in other cases, internal urethrotomy may be necessary, but should be done only on strictures anterior to the bulbous urethra. External urethrotomy should be avoided on account of the danger of establishing a permanent urethral fistula. Whichever is done, dilatation or urethrotomy, a tuberculous stricture will close down rapidly and require constant attention.

Many authorities are now agreed that tuberculin is a valuable adjunct in the treatment of genital tuberculosis, especially after operation. We have used it for a number of years in the after-treatment of both genital and urinary tuberculosis. Our opinion of it and the details of its use have been set forth by O'Neil and Hawes.<sup>43</sup>

"Tuberculin injections are used in conjunction with other measures, but in few if any cases would we be willing to attribute to tuberculin, all or nearly all of the improvement. In some of the genito-urinary cases it has seemed as if tuberculin was an important factor in the treatment; in the great majority of cases, however, while a factor, it is by no means the most important one in producing results. The tuberculin used is a bouillon filtrate (or bacillary emulsion) supplied by Dr. E. R. Baldwin of the Saranac Lake Laboratory.\* It is administered once a week according to the rules of Trudeau, the initial dose being from 0.0001 mg. to 0.0005 mg., rarely 0.001 mg. This is gradually increased to 50 to 100 mgs. The increase in dosage is gauged by careful observation of clinical signs of reaction, local, focal or constitutional. Constitutional reactions have been rare and no untoward results have followed such as have occurred. Occasionally benefit has seemed to follow a mild constitutional disturbance. It is the aim, however, to avoid all such, and as a rule it has been possible to carry patients up to large amounts without discomfort. . . . As the local and general conditions improve, the patients are allowed to come once in two weeks and when the process is arrested, to report once a month or once in two months."

As I have stated elsewhere,<sup>6</sup> "it all comes down to a question of

\* It may also be obtained from the H. M. Alexander Co., Marietta, Pa. Solutions suitable for immediate use, without further dilution, may be had by special arrangement.

immunity. Once fortified in this manner a patient can ward off an onslaught of the tubercle bacillus, which, under other circumstances, would get the upper hand in a short time. While we have all seen patients with surgical tuberculosis, who have fought single-handed a winning battle for many years, we should not hesitate to bring to their relief the best of hygienic treatment, the regular and continuous administration of sandalwood oil, and the use of tuberculin. . . . Under these conditions whatever natural immunity the patient may possess, or has acquired, will be raised to the highest possible point, a factor which I believe will give the victims of this disease a better outlook in the future than they have had in the past."

## BIBLIOGRAPHY.

1. Asch: *Zeit. f. Urol.*, 1909.
2. Balliano: *Beit. zur Klinik der Tuberkulose*, 1912.
3. Barney: *Am. Jour. Urol.*, 1911; *Boston Med. and Surg. Jour.*, clxviii, 1913.
4. Barney: *Boston Med. and Surg. Jour.*, 1912, clxvi, No. 11.
5. Barney: *Jour. Am. Med. Assn.*, December 31, 1914.
6. Barney: *Surg., Gynec. and Obst.*, March, 1914.
7. Baudet: *Rev. de Chir.*, 1901, i.
8. Baumgarten: *Arch. f. klin. Chir.*, 1901, lxiii.
9. Baumgarten: *Langenbeck's Arch.*, 1901, Bd. lxiii, H. 4.
10. Baumgarten: *Verhandl. der deutsch. path. Gesellschaft*, 1905; *Arbeiten aus dem path.-anatom. Inst. zu Tübingen*, 1906, v.
11. Belfield: *Jour. Am. Med. Assn.*, October 19, 1912.
12. Berger: *Arch. f. klin. Chir.*, 1902, lxviii.
13. Brown: *Jour. Am. Med. Assn.*, 1915, lxiv, No. 11.
14. Buday: *Virchows Archiv*, 1906.
15. Cabot and Barney: *Jour. Am. Med. Assn.*, 1913, lxi.
16. Cholzoff: *Folia Urologica*, 1908-09, iii.
17. Crandon: *Boston Med. and Surg. Jour.*, 1902, clxvii.
18. Davids: *Inaug. Dissert.*, Göttingen, 1898.
19. Delli Santi: *Riforma Medica*, 1903, No. 34.
20. Dreyer: *Inaug. Dissert.*, Göttingen, 1891.
21. Ferron: *Jour. d'Urol.*, June 15, 1913.
22. Götzl: *Folia Urologica*, 1912-13, vii.
23. Guisy: *Ann. des Mal. des Org. Génito-urinaires*, 1906.
24. Haas: *Beit. zur klin. Chir.*, 1901, xxx.
25. Hallé and Motz: *Ann. des Mal. des Org. Génito-urinaires*, 1903.
26. Hesse: *Cent. f. der Grenzgebiete der Med. und Chir.*, 1913, xvii.
27. Heyn: *Virchows Archiv*, 1901.
28. Huet: *Centralbl. f. Bakt.*, 1909, lii.
29. Hueter: *Ziegler's Beit.*, 1904.
30. Jannsen: *Sammlung klin. Vorträge*, 1910-11.
31. Kantorowicz: *Inaug. Dissert.*, Berlin, 1893.
32. Kappis: *Inaug. Diss.*, Tübingen, 1905.
33. Keyes: *Ann. Surg.*, June, 1907.
34. Kocher: *Deut. Chir.*, 1887, Bd. 1.
35. Kocher: *Deut. Chir.*, 1887, 1.
36. König: *Deut. Zeit. f. Chir.*, 1898, xlvii.
37. Kowalewsky: *Jahresb. der ges. Medizin*, 1907.
38. Kraemer: *Wien. med. Wehnschr.*, 1900, 1; *Deut. Zeit. f. Chir.*, 1903, lxix.
39. Kraemer: *Ziegler's Beit.*, 1904.
40. Krzywicki: *Ziegler's Beitr.*, 1888, iii.
41. Kuhn: *Jahresb. der ges. Med.*, 1906.
42. Lapeyre: *Arch. gén. de chir.*, 1912, viii.
43. Le Dentu: *Bull. et mém. Soc. de chir. de Paris*, 1912, xxxviii.
44. Lelongt: *Thèse de Paris*, 1911.
45. Lowenstein: *Deut. med. Wehnschr.*, 1913, xxxix.
46. Marinesco: *Jour. d'Urol.*, 1912, i.
47. Meyer: *Virchows Archiv*, 1895.

48. O'Neil and Hawes: Tr. Am. Assn. Genito-Urin. Surg., 1913, viii.
49. Oppenheim and Löw: Vichows Archiv, 1905, clxxxii.
50. Paladino-Blandini: Ann. des mal. des Org. Génito-urinaires, 1900.
51. Pinaud: Seifert, Dermatologische Studien, 1903-1910.
52. Reclus: Thèse de Paris, 1876.
53. Rolly: Jahresb. f. ges. Med., 1909.
54. Samuel: Wiener klin. Rundschau, 1911, No. 47.
55. Sangiorgi: Cent. f. allg. Path. und path. Anat., 1909, xx.
56. Sawamura: Deut. Zeit. f. Chir., 1909-10, ciii.
57. Sawamura: Folia Urologica, 1910, Bd. iv.
58. Saxtorph: Cong. Internat. de Chir. Urin., 1900.
59. Schmidt: Inaug. Dissert., Tübingen, 1896.
60. Simon: Deut. Gesellschaft f. Chir., 1901, xxx.
61. Spano: Rev. de la Tuberculose, December 31, 1903.
62. Sugimura: Arbeiten auf dem Gebiete der path. Anat. und Bakt., 1912, viii.
63. Téstud: Traité d'Anatomie Humaine, 1897.
64. Teutschländer: Beitr. zur Klinik der Tuberculose, 1905.
65. Teutschländer: Beitr. zur Klinik der Tuberculose, 1906.
66. Tylinski: Deut. Zeit. f. Chir., 1911, cx.
67. Uchimura: Sei-I-Kwai Med. Jour., 1914, xxxiii.
68. Vignard and Thévenot: Ann. de Méd. et Chir. Infantiles, 1911, xv.
69. von Bruns: Deut. Gesellschaft f. Chir., 1901, xxx.
70. Walker, George: Johns Hopkins Hosp. Rep., 1911.
71. Walker, K. M.: Lancet, 1913, i.
72. Walker and Hawes: St. Bartholomew's Hosp. Rep., 1911, xlvii.
73. Whiteside: Tr. Am. Assn. Genito-urinary Surg., 1914, ix.
74. Wyssokowicz: Zeit. f. Hyg. und Infektionskrankheiten, 1908.

## CHAPTER XVII.

### TUMORS OF THE TESTICLE.

By EDWIN BEER, M.D.

**Frequency.**—Tumors arising in the testis are not frequent. According to Howard,<sup>9</sup> in 110,000 patients there were 65\* malignant testicular neoplasms. Other statistics show a higher incidence, 1 to every 1000 males.

**Etiology.**—Neoplasms are thought to be relatively more common in *undescended testicles* than in normally placed organs. In Howard's 110,000 patients (*vide supra*), out of 57 cases of malignant disease 9 (15.7 per cent.) occurred in undescended testicles, which is out of all proportion to the relation between normal and abnormally placed testicles. Odiorne and Simmons<sup>14</sup> similarly found in 54 malignant cases 6 in undescended testicles; 4 of these were abdominal and 2 inguinal. Intra-abdominal testicular retention has been thought to be more likely to lead to malignancy than the facts seem to warrant. In Bulkley's<sup>3</sup> statistical study he concludes that malignant disease of the abdominal testicle is relatively rare (1 to 60,000 patients). Of the malignant non-descended testicles, 25 per cent. are abdominal. "About 1 of each 75 abdominally retained testes will become malignant."

**Trauma** has frequently been claimed to lead to neoplasms. For instance, of late Sekaguchi reported 32 cases and in 4 he thought the tumor followed trauma. T. Miyata<sup>12</sup> found in 50 per cent. of a series of 20 cases a similar etiological factor. Undescended inguinal testicles are peculiarly exposed to repeated traumata and here this may prove an etiological factor, just as in other parts of the body chronic irritation seems to be of importance. It is, however, more than doubtful whether single injuries do more than call attention to previously unnoticed developments. Metastases in the testis are very infrequent.

**Pathology.**—As Adami<sup>1</sup> says, the variety of forms of testicular neoplasm is bewildering. There is probably no field of pathology in which more divergent views have been and still are current. On the one hand, we find described all varieties of neoplasms, and on the other, we find almost all gathered together as *teratomata*. Ziegler (1902) describes adenoma, adenocystoma, adenomatous teratoma, chondro-adenoma, chondrocystoma, adenosarcoma, carcinoma, chondrocarcinoma, enchondroma, fibroma, myomastriocellulare, myxoma, osteoma, sarcoma, lymphosarcoma, alveolar sarcoma, endothelioma, and dermoids. E. Kaufman<sup>11</sup> (1911) describes a number of rare types, such as fibroma, lipoma, myxoma, myoma, chondroma, osteoma, and then the more

\* Fifty-seven verified microscopically by Howard.

common types, such as sarcoma, adenoma, adenocystoma, carcinoma, dermoid cysts, teratoma, and chorio-epithelioma.\* At the opposite extreme, Ewing<sup>6</sup> concludes that the "commonest tumor of the testis is an embryonal carcinoma, alveolar or diffuse, with polyhedral or rounded cells and often with lymphoid stroma. These tumors are probably one-sided developments of teratomata." Wilson finds that all of 19 tumors that could be studied histologically in detail proved to be teratomata. Fibroma, leiomyoma, lymphosarcoma, spindle-celled sarcoma, adenoma, Ewing admits as exceptional or unique occurrences.

Of late years the tendency toward a teratomatous explanation has become stronger and stronger. More careful study of tumors that were originally classified as sarcoma or carcinoma, etc., have demonstrated a tridermal constitution (Wilms). The Marchand-Bonnet explanation of the origin of these neoplasms as well as of ovarian teratomata, from isolated blastomeres has gradually obtained more adherents, especially since it has been shown (Wilms, Pick) that one element may dominate the histological picture. Further studies will decide whether pure carcinoma (seminoma) derived from seminiferous tubule epithelium is an entity or not. Chorio-epithelioma (Schlagenhauser)†‡ invading the veins, as in the female, is a rare but well-recognized type.

The complexity of the microscopic picture of most of these tumors can be readily grasped when one bears in mind that any type of tissue (tridermal) may be represented. On the other hand, there is some uniformity in the gross appearance and in the method of progression exhibited by these neoplasms which are usually malignant.§ They usually commence in the body of the testis near the epididymis, perhaps occasionally in the latter.<sup>5</sup> At this early stage one rarely sees them clinically. As they grow the albuginea stretches and the whole organ seems to enlarge more or less symmetrically, though on cross-section one may see that the growth has compressed the adjacent testicular tissue. On cross-section they may be solid or in part cystic. Areas of necrosis are not rare. In some cases fluid accumulates in the tunica vaginalis, but usually the amount of fluid is small. In some cases this may become bloody. Rarely the growth perforates the scrotal skin and produces a fungus. Extension is usually by the lymphatics, though some tumors behave like the chorio-epitheliomata which rapidly spread through the veins. The retroperitoneal (lumbar and aortic) glands are first involved. The local inguinal glands may become involved.<sup>10</sup> Metastases occur in the bronchial glands, lungs, liver, spleen, intestines, kidneys, spinal cord, etc.

In intra-abdominal testis such malignant tumors may grow into

\* Chevassu,<sup>4</sup> in 128 cases, found 59 seminal epitheliomata (seminoma) and 62 embryomata (Thèse de Paris, 1906).

† W. Risel from Marchand's Laboratory, derives these growths from fetal ectoderm just as in similar growths in females.

‡ According to Sternberg,<sup>16</sup> these are perithelial sarcomata.

§ In these pages testicular neoplasms are discussed almost entirely from this standpoint in the interest of the patient. Almost all these tumors are clinically malignant, though occasionally benign growths that do not produce metastases occur.

adjacent structures, so that their removal becomes impossible. Adjacent viscera, vessels and nerves may become involved by continuity.

**Clinical Picture and Diagnosis.**—The clinical picture presented by these growths is confusing. Some begin to grow in early life and grow very gradually and slowly. They present themselves as rather firm and uniform testicular enlargements. Others are seen in more advanced life and are characterized by the more rapid development of very hard nodules in the testicle. Others, again, develop in children and young men, grow rapidly and cause uniform firm, elastic enlargement of the testicle. Between the ages of eighteen and forty-five neoplasms are most common.\* All are characterized by producing a marked increase in weight of the involved organ. Pain at first is absent but later may be very severe. Local tenderness may be very slight and testicular sensation is usually preserved. A hydrocele may obscure the underlying trouble.

As there is nothing absolutely typical of these growths, their recognition often depends upon the exclusion of other testicular diseases, especially of syphilis and of tuberculosis.† Syphilis usually produces irregular testicular tumors which are very heavy and often not tender. The presence of a positive Wassermann and rapid diminution in size following antisyphilitic therapy will often clear up the diagnosis. One must, however, always bear in mind that constitutional syphilis may complicate a testicular neoplasm and not delay the diagnosis more than a few weeks with antisyphilitic therapy. It is preferable to occasionally remove a syphilitic testicle than to delay in the removal of a malignant tumor. Tuberculosis rarely mimics a new growth. It usually begins in the epididymis, producing a finely nodular enlargement and involves the testicle later. The vas becomes beaded and enlarged. The skin may become adherent and fistulæ may form within a few weeks. By rectum the vesicle of the same side as well as the prostate may show thickening and nodules. Sometimes one may be in doubt and in these cases old tuberculin<sup>2</sup> may be very useful in establishing a diagnosis.

When the testicle is situated in an abnormal position the symptoms may be much more marked, *e. g.*, when in the inguinal canal, or they may not be noticed at all until the growth presses on adjacent structures, *e. g.*, in abdominally retained testis. Here pressure on veins and edema, or pressure on nerves producing neuralgia may be the first symptoms.

In these cases the history of the patient and the absence of testicle in the corresponding half of the scrotum are of great importance in arriving at a correct diagnosis.

In all cases that are suspicious of neoplasm the testicle should be exposed (*vide post*) and the diagnosis made by inspection if it cannot be made otherwise. In dealing with such a serious condition as malignant disease of the testicle delay and hesitation are fatal.

\* Chevassu<sup>4</sup> found seminomata 34 times in 59 cases between the ages of thirty-five and forty-five years; embryomata 45 times in 61 cases between eighteen and forty years.

† A thickened tunica vaginalis or a hematocele may simulate a neoplasm.

**Prognosis.**—It is well recognized that the outlook for patients suffering from tumors of the testicle is not good. Whether the results are going to improve with more extensive removal of the retroperitoneal glands,<sup>15</sup> just as more extensive operations in other parts have given better results, one cannot say as yet. With the older procedure of simple castration, Nicholson<sup>13</sup> reports on 18 patients that were followed; 12 of these died within one year of the operation, and 6 were alive one to five years after operation. In Howard's<sup>9</sup> series of 57, only 21 patients could not be followed. Of the remaining 36, 8 were alive some time after operation, but only 2 were definitely known to be alive three years after operation; 27 of the 36 had recurrences, 2 local and 18 glandular and distant. Chevassu thinks the prognosis is perhaps as bad as in malignancy in any organ, and estimates that only 19 per cent. live to the four-year limit free from recurrence.\*

Hinman,<sup>8</sup> reviewing the cases examined at Johns Hopkins and in local laboratories, found that only 4 patients out of 24 were alive. Of the 9 teratomatous cases, all except 1 patient had died, and he had been operated only sixteen months before. Of 9 round-cell carcinoma cases, 2 patients were alive twelve to thirteen years.

On the other hand, Codman and Sheldon,<sup>5</sup> in an analysis of 56 operated cases, come to the conclusion that the results of operations are more than twice (41 per cent. cures) as good as those just reported, and if the operation is done before palpable metastases have developed, 52 per cent. will be cured.

These more favorable data are open to criticism, as the cases had not been followed long enough. For instance, of the 13 patients who were alive, the period since operation was from two to twenty-eight years. Moreover, of the 10 other patients (making 23 out of 56, or 41 per cent.) 1 had died seven months after operation following burns, and another three years after operation following an injury. Whether autopsies had proved that these were free from cancer is not stated. Even Chevassu's four-year limit does not seem to be sufficient, as recurrences have been noted later.

A review of the literature demonstrates that the more cellular type of neoplasin produced secondary deposits later than the cases with more distinct teratomatous arrangement. In other words, the prognosis in the latter type seems more unfavorable than in the former, as it spreads more rapidly through the lymphatics into the thoracic duct and thence into the blood stream.

The extensive operation advocated more and more during the last decade attempts to remove *en bloc* all the lymphatic bearing retroperitoneal fat†, starting well up (Fig. 227) near the renal vein and coming down to the iliac fossa and spermatic cord and testicle. Hinman has collected some 46 cases (mortality 11 per cent.) in which this operation was more or less thoroughly carried out, and found that 16 (41 per cent.)

\* Recurrences after four years have been reported.

† Through the courtesy of Dr. Hinman, the excellent plates used in his paper, referred to above, are here reproduced.

died of cancer within one to four years. This series throws no direct light upon the end-results of this extensive operation, as compared with those obtained by simple castration, though indirectly these cases demonstrate very clearly that the glandular metastases were present in 50 per cent. of the cases and that simple castration under such conditions would have been useless. If any of these cases are saved, it will be due to the radical procedure. Glandular involvement is difficult to recognize before operation even though it is so extensive as to preclude radical removal. In this series such was the case in 11 patients.

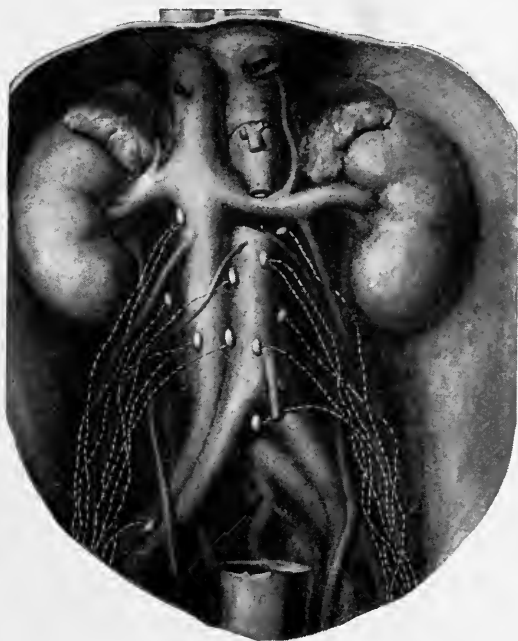


FIG. 227.—Primary lymph nodes of the testicles. (From Spalteholtz and dissections.)

**Treatment.**—In view of what has just been said concerning the difficulty in diagnosis and the bad outlook, the interest of the patient demands that all enlargements of the testicle that are not frankly non-neoplastic should be exposed and their exact nature determined by inspection and microscopic examination in the operating room. This procedure can be carried out with perfect safety by exposing the cord at the internal ring, after incising the anterior wall of the inguinal canal and then throwing a rubber ligature about the cord so that in the manipulations to liberate the testis from the scrotum no tumor cells are forced into the general circulation. After delivering the enlarged testis, inspection may demonstrate that the enlargement is neoplastic. If in doubt, after carefully protecting the wound, an incision should be made and a piece of the suspicious tissue immediately examined under the microscope. The peculiar structure of these growths can be readily



FIG. 228.—Peritoneum stripped back showing lymph area to be removed.



FIG. 229.—Lumbar and iliac fossæ stripped clean of glands and fascia with the spermatic vessels down to the inguinal ring. Vas deferens entering pelvis at point where it is divided.

identified and then the castration completed.\* By enlarging the original incision from the internal ring toward the lumbar region, as shown in the accompanying illustrations (Figs. 228 and 229) borrowed from Hinman's paper, a retroperitoneal exposure of the gland-bearing area is obtained. This area should be excised from above downward, beginning near the renal pedicle. Even though at present the mortality of this operation is much higher than that of simple castration, experience has shown that such is the case with all new operations. The writer feels confident that during the next decade the mortality from this extensive operation will be markedly reduced. Moreover, he believes that we are justified in expecting better end-results when the gland-bearing area is removed. Operations for malignant disease in other parts surely support this position. The fight against cancer cannot be halfhearted: the surgeon must strike hard or fail in his duty.

**Recurrences and Inoperable Cases; Postoperative Prophylaxis.**—Local recurrences may be amenable to excision, whereas distant deposits are probably always only a part of multiple metastases and therefore not operable. In these cases, as well as in the inoperable cases, an attempt should be made to control the disease with Coley's fluid, which, according to his recent report, has given some encouraging results. Coley and others advise the prophylactic administration of this fluid, after removal of the original trouble, to prevent recurrence. It is naturally impossible to estimate its efficacy in this field.

#### BIBLIOGRAPHY.

1. Adami: Text-book of Pathology, 1914, 2d edition.
2. Beer: Med. Rec., October, 1913.
3. Bulkley: Surg., Gynec. and Obst., 1913.
4. Chevassu: Thèse de Paris, 1906.
5. Codman and Sheldon: Boston Med. and Surg. Jour., February, 1914.
6. Ewing: Surg., Gynec. and Obst., 1911.
7. Gregoire: Jour. Am. Med. Assn., 1914.
8. Hinman: Jour. Am. Med. Assn., 1914.
9. Howard: Practitioner, December, 1907.
10. Howard and Miyata: Langenbeck's Archiv, ci.
11. Kaufman: Lehrb. path. Anat.
12. Miyata: Langenbeck Archiv, ci.
13. Nicholson: Guy's Hosp. Rep., lxi.
14. Odiorne and Simmons: Ann. Surg., 1904.
15. Roberts: Ann. Surg., 1902.
16. Sternberg: Zeit. f. Heilk., 1905, xxvi.

\* If no neoplasm is present, the testis is sewed up and returned to the scrotum after removal of the hemostatic ligature of the cord.

# SECTION IV.

## THE PROSTATE AND SEMINAL VESICLES.

---

### CHAPTER XVIII.

#### ANATOMY AND PHYSIOLOGY OF THE PROSTATE AND SEMINAL VESICLES.

By WM. C. QUINBY, M.D.

#### PROSTATE.

**Definition.**—The prostate is the most important of the male accessory genital glands. It is a musculoglandular organ lying between the outlet of the urinary bladder and the triangular ligament, and enclosing within its substance the first, or prostatic, portion of the urethra and ejaculatory ducts. It shows a somewhat different morphology at the three periods of life: infancy, puberty and old age.

**Embryology.**—For a clear understanding of the anatomy of the prostate a knowledge of its embryological development is most important. Indeed, it is only since the relatively recent studies on the formation of this organ, by Weski, Pallin,<sup>9</sup> Porosz,<sup>12</sup> and Lowsley,<sup>7</sup> that there has existed any unanimity of opinion among anatomists and surgeons as to the relative importance and significance of the various lobes which together constitute the gland.\*

At about the third month of intra-uterine development the walls of the urethra, just below the bladder proper, show two small longitudinal depressions—the so-called prostatic furrows; and at the same time there are seen clumps of cells lying in the wall of the urethra, which in a short time, by a process of budding, become differentiated into glandular masses and tubules. These glandular elements penetrate the surrounding muscular and embryonic connective tissue in five distinct groups. One group takes its origin from the posterior midline of the urethra, just above the openings of the ejaculatory ducts; one on either side from each prostatic furrow and lateral urethral wall; one from a point just below the ejaculatory ducts, and one from the anterior wall of

\* Of these studies by far the most important are those of Lowsley, to whom the writer is indebted for many of the points brought forward in this present account.

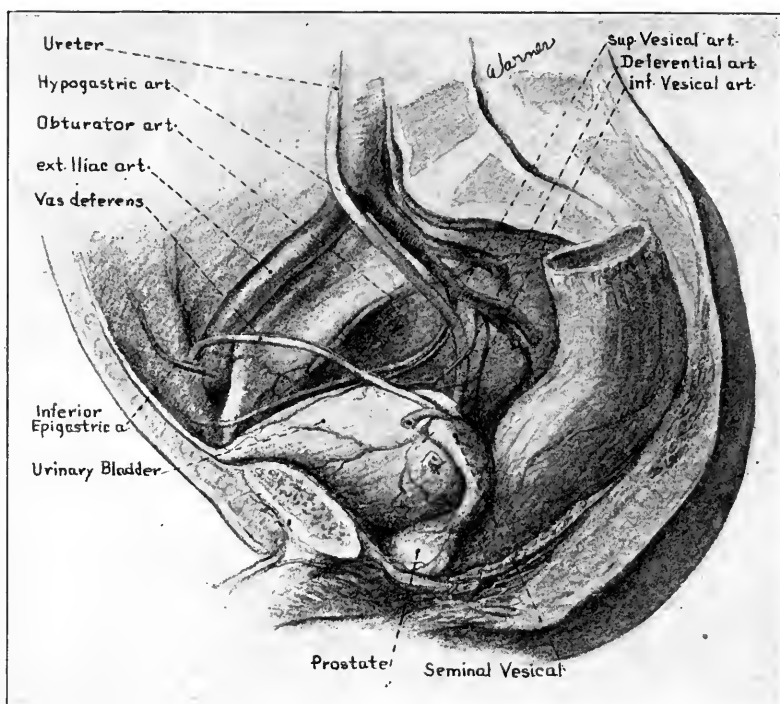


FIG. 230.—Arteries of the pelvis.

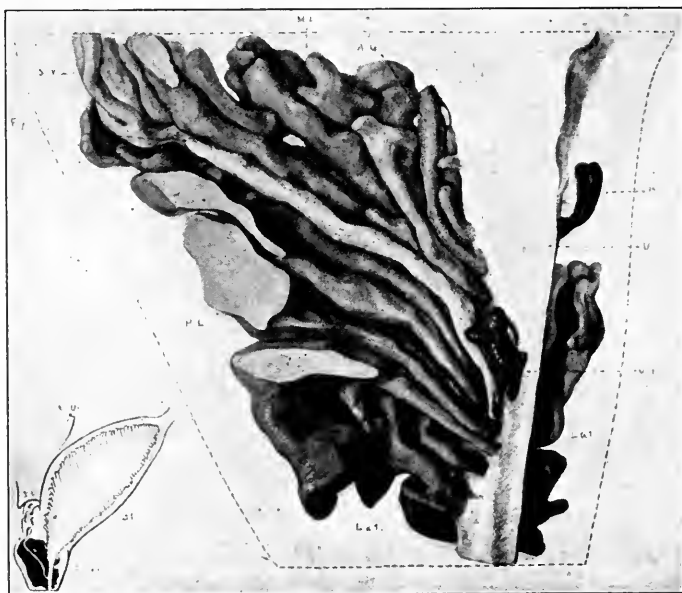
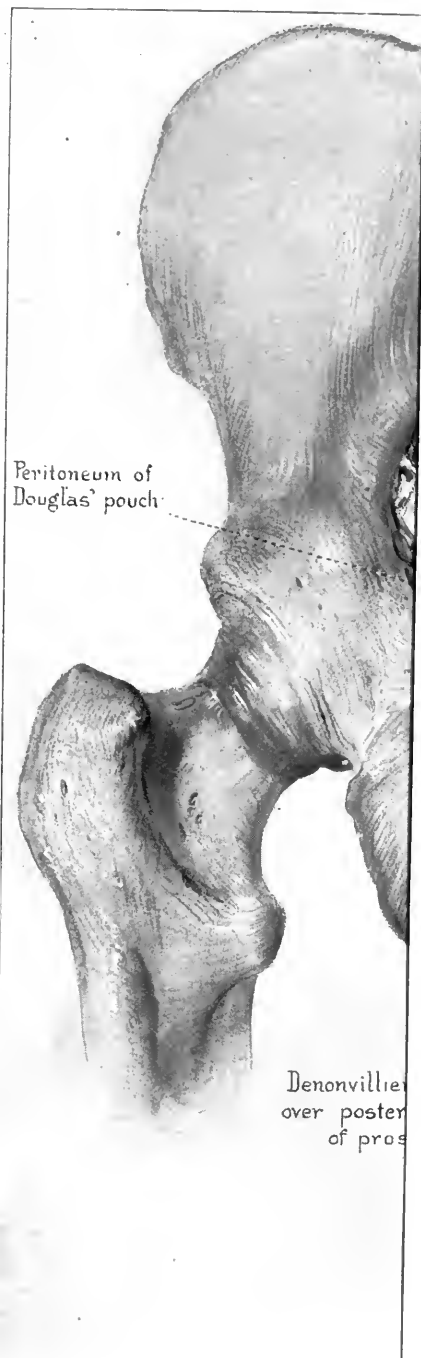


FIG. 231.—Sagittal view of a wax model of the prostate of a newborn infant.  $\times 14$ . (From Lowsley.) *Lat.*, anterior branches of lateral lobes; *P.L.*, posterior lobe; *E.J.*, ejaculatory duct; *S.V.*, seminal vesicle; *A.L.*, anterior lobe tubule; *U.*, urethra; *U.P.*, utricle; *A.G.*, subcervical glands of Albarran; *M.L.*, middle lobe tubules; *L.Ur.*, left ureter; *Bl.*, bladder; *P.Gl.*, prostate gland.



Dissection of Prostate and  
the Location of the Periton  
Coccyx have been Removed.



the urethra, opposite the others. These form respectively the middle, two lateral, posterior and anterior lobe glands. The middle lobe tubules grow posteriorly between the ejaculatory ducts and the urethra. Those of the two lateral lobes also grow backward, and later form almost the whole of the base of the organ. They are not separated from the middle lobe by an intraglandular capsule. The tubules of the posterior lobe, arising below the ejaculatory ducts, grow backward behind these structures and are definitely separated from the lateral lobes by a fibrous intraglandular partition. The anterior lobe tubules, few in number at any stage, gradually disappear, until at birth the lobe is represented only by two or three glandular masses. As a rule this lobe remains insignificant, or it may even disappear entirely.

Two other small groups of glands remain to be mentioned—the so-called subcervical and subtrigonal. The first of these, also called the group of Albarran—who was the first to call attention to its importance—appears to be constant after the sixteenth week, while the subtrigonal group makes its appearance at about the twentieth week. These two glandular masses lie closely underneath the urethral and bladder mucosa and are of importance only because of their ability easily to cause obstruction to urinary outflow if they become enlarged.

The ejaculatory ducts run from above downward and forward obliquely through the substance of the prostate. They penetrate the posterior wall of the prostatic urethra on both sides of the utricle. This structure, the remains of the fused Müllerian ducts—an analogue of the vagina in the female—is seen as a blind tube running for a shorter or longer distance backward into the substance of the prostate. The prominence known as the verumontanum, on the posterior wall of the urethra, is composed of the utricle with the ejaculatory ducts and their envelopes.

**Gross Anatomy.**—The shape of the prostate is somewhat that of a truncated cone with apex downward, flattened anteroposteriorly. The average dimensions of the adult gland are 3.4 cm. in length, 4.4 cm. in width, and 2.6 cm. in thickness. In consistency it is firmly elastic. A base, apex, anterior, posterior, and two lateral surfaces are described.

The base is about one-third wider laterally than anteroposteriorly. It is concave and is directly apposed to the neck of the bladder and to the tips of the seminal vesicles. It is pierced by the urethra, and behind this in a short transverse groove by the entrance points of the two ejaculatory ducts. This groove divides a posterior from an anterior area.

The apex is in relation with the triangular ligament, and gradually becomes merged with the musculature of the membranous urethra.

The anterior surface of the gland, flat centrally and becoming convex laterally, looks toward the symphysis pubis, from which it is separated by cellular tissue and by the liberal plexus of veins known by the name of Santorini.

The two rounded lateral surfaces are closely related to the fibers of the levator ani muscle.

The posterior surface is that part of the gland which can be palpated by rectum. It is broader above than below, and in the midline shows a shallow vertical groove, which fades out toward the apex.

On the posterior wall of the initial portion of the urethra contained within the substance of the prostate is seen a longitudinal elevation, known as the verumontanum. On both sides of the midline of this are the openings of the ejaculatory ducts, while in the middle and slightly above there occurs the slit-like opening of the utricle. On each side and below the verumontanum are seen the minute openings of the prostatic ducts.

The fascial planes surrounding the prostate are important, although their description, as found in various anatomical works on the subject, differs considerably. This seems to be largely due to the well-known variations in development of the levator ani muscle, some subjects showing a marked increase over others in actual muscular fibers. Accordingly this so-called pelvic diaphragm has no absolutely constant

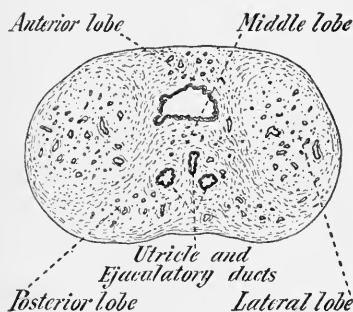


FIG. 232. — The prostate in cross-section. Semidiagrammatic camera-lucida sketch.

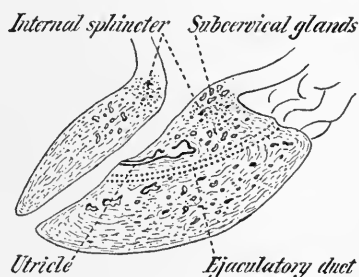


FIG. 233. — The prostate in sagittal section. Semidiagrammatic camera-lucida sketch.

amount of fibrous expansion. For practical purposes, however, the description of Denonvilliers,<sup>3</sup> one of the first to study the subject, is sufficiently accurate. He describes a *puboprostatic aponeurosis*, running anteriorly from the prostate to be inserted into the posterior surface of the symphysis pubis. This is made up of two resistant fibrous layers on each side of the middle line, which sometimes bear the name of anterior ligaments of the bladder. Between these there is a space of about a centimeter, filled by a delicate but quite resistant fibrous tissue, pierced by numerous holes, through which run the dorsal veins of the penis to reach the venous plexus at the neck of the bladder.

At its apex the prostate is supported by the deep layer of the triangular ligament—the trigonum urogenitale of the newer nomenclature.

On each side is found the so-called *lateral aponeurosis of the prostate*. This runs from the descending rami of the pubis, backward to join the rectum; and by it the prostate is separated from the median margins of the levator ani muscle. It is closely applied to the sides of the gland

and is united to it by the cellular tissue containing the vesical plexus of veins.

Behind the prostate, separating it and the seminal vesicles from the rectum, there is a transverse aponeurosis, known commonly as the fascia of Denonvilliers, but which he calls the *prostatoperitoneal fascia*. He describes this layer as attached below and anteriorly to the tip of the prostate and triangular ligament, and united above to the peritoneum, which descends between the bladder and the rectum. "This last union is as marked as though there existed continuity of tissue, and explains the constancy of the rectovesical cul-de-sac" (Douglas's fossa). On each side this fascia is attached to the lateral aponeurosis described above. By its posterior surface it is but loosely attached to the rectum,



FIG. 234.—Microscopic section of prostate. ( $\times 90$ .) Branching tubular glands surrounded by smooth muscle fibers and connective tissue.

but by its anterior surface it is quite firmly attached to the seminal vesicles and to the true capsule of the prostate gland. The texture of this membranous layer is said to resemble that of the dartos. It is probably a fascia resulting from the obliteration of the embryonic urorectal septum.

All these surrounding prostatic fasciæ make up the prostatic bed—the *loge prostatique* of the French writers—and thus serve to control the direction and spread of suppurations in this area. The posterior fascia of Denonvilliers is also of surgical importance, because only by incising it can access to the gland be had in the operation of prostatectomy by the perineal method of Young.

Besides these aponeuroses described above the prostate has a true capsule of its own which sends prolongations between the gland lobes.

*Bloodvessels, Lymphatics and Nerves.*—The arteries of the prostate are branches of the middle hemorrhoidal, of the inferior vesical, and of the internal pudic. The veins become grouped on the lateral and anterior surfaces of the gland, whence, after receiving the dorsal veins of the penis, they eventually empty into the internal iliacs. The lymphatics begin about the gland acini, and following the bloodvessels, drain into the lymph nodes situated on the hypogastric and iliac arteries. They are very numerous.

The nerves of the prostate are derived from the hypogastric plexus of the sympathetic and also from the anterior roots of the third and fourth sacrals. These show many ganglion cells and variously constructed end-organs, situated chiefly at the periphery of the organ. From the elaborate studies of Timofeew<sup>15</sup> it is known that these nerves are medullated as well as non-medullated, some of them showing structures resembling the Pacinian corpuscles.

**Normal Histology.**—The microscopic picture presented by the prostate is that of a gland of the compound tubular type. Each tubule is surrounded by smooth muscle fibers arranged in a circular fashion. Cylindrical cells with a basal nucleus line these tubules in a single layer. Occasionally a round or conical cell is interposed between them. The gland ducts are quite short and are lined by a single layer of cuboidal cells, which gradually become identical with those lining the urethra. The smooth muscle surrounding the ducts is laid down in a longitudinal rather than circular arrangement. Beginning just above the verumontanum there is a thick mass of circular smooth muscle fibers laid down in a ring about the urethra. These form the internal vesical sphincter. Superiorly the fibers are continuous with the middle circular coat of the bladder. Elastic and connective-tissue fibers are quite numerous throughout the gland, and an occasional area of lymphoid tissue may also be seen. The relative amount of glandular tissue to muscular and supporting structures throughout the gland is about as five to one in the adult prostate.

### SEMINAL VESICLES.

**Definition.**—The seminal vesicles may be described as a pair of convoluted organs lying at the base of the bladder, between it and the rectum, and converging diagonally toward the midline, to empty into the ejaculatory ducts.

**Embryology.**—Together with the ejaculatory ducts the seminal vesicles appear at about the third month of intra-uterine life as lateral evaginations of the Wolffian duct. At the fourth month the vesicles begin to show diverticula, and soon after this assume the general topography which they retain until puberty. At this period there is a marked increase in the size of these organs, as well as an addition to the number and diversity of their diverticula.

**Gross Anatomy.**—The adult seminal vesicle shows an extreme individual variation in size as well as in the number and kind of diverticula,

both in the filled and empty condition. Its cubic volume ranges from one to three, or even eleven, cubic centimeters in the single vesicle.

The average length is from forty-five to fifty-five millimeters; the average breadth from fifteen to twenty millimeters, and the average thickness about ten millimeters. Also in a single individual, one vesicle may be of different size and shape from its fellow. On external view the vesicles appear as somewhat long

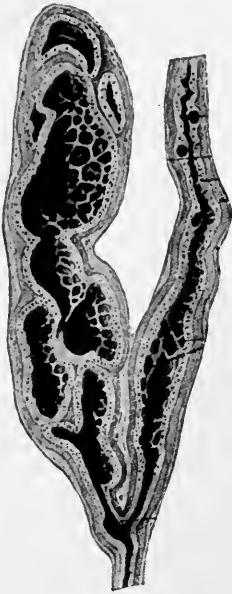


FIG. 235.—Left seminal vesicle and ampulla of vas deferens in section, seen from behind. (From Eberth: *Männliche Geschlechtsorgane*.)



FIG. 236.—Simple convoluted type of seminal vesicle. (From Pieker; Type C.)

organs, flattened anteroposteriorly and with an irregularly corrugated surface, which has been likened to an area of varicose veins.



FIG. 237.—Radiograph of injected vesicles and vasa deferentia. (From Pieker; Type B.)

The inner surface of the vesicles is in relation with the vas deferens and its ampulla, with which the vesicles are united by an embracing fascia. By their anterior surfaces they are closely approximated to the

posterior surface of the bladder wall. The upper portion of their outer surfaces (upper pole) lies against the ureter just at the beginning of its intravesicular portion, while on the posterior surface the vesicles are separated from the rectum by the peritoneum of Douglas's fossa in their upper third, and by the fascia of Denonvilliers in their lower two-thirds.



FIG. 238.—The vesicles, ampullæ of vasa deferentia, and initial portion of ejaculatory ducts shown by the corrosion method. (From Pallin.)

The varieties of diverticula have been carefully studied by Pallin,<sup>9</sup> by the corrosion method. He groups the vesicles under two main

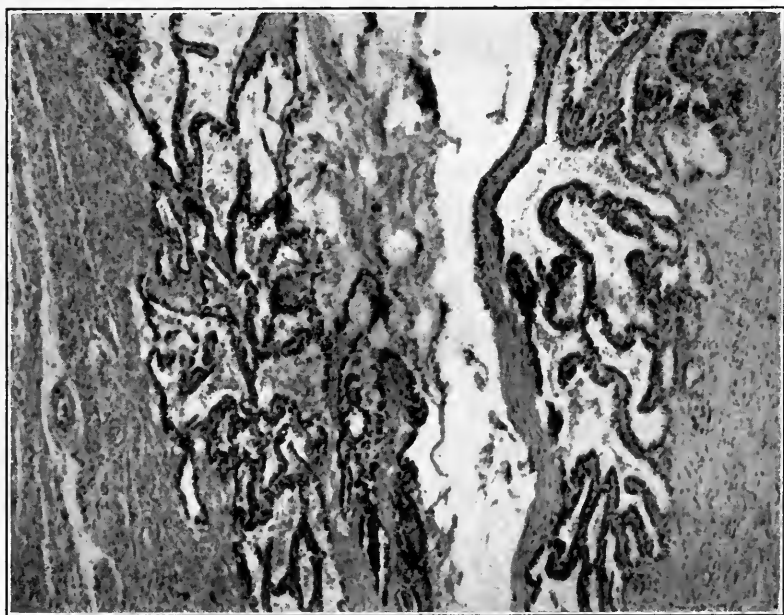


FIG. 239.—Microscopic section of seminal vesicle. ( $\times 90$ .) Very tortuous glands filled with secretion and spermatozoa, and surrounded by a thick muscular wall.

headings; (*a*) those with slightly convoluted main channels, and (*b*) those with the main channel markedly convoluted. Under each division he makes two subheadings, according as the diverticula are short and uniformly developed, or irregularly developed and themselves convoluted. A still more comprehensive study has been made by Picker,<sup>10</sup>

who injected collargol or bismuth paste into the vesicles in 150 subjects and then examined them by radiographs. He divides his material as follows:

Vesicles showing:	Per cent.
A. Simple straight tubes . . . . .	3.5
B. Thick, twisted coils with or without very small diverticula . . . . .	15.0
C. Thin, twisted tubes with or without diverticula . . . . .	15.0
D. Straight or twisted main channel with large bulbous diverticula . . . . .	33.0
E. Short main channels; large branched, irregular accessory channels . . . . .	33.0
F. Varia . . . . .	0.5

**Bloodvessels.**—The blood supply of the seminal vesicles is large. It is derived from the middle hemorrhoidal and inferior vesical branches of the internal iliac artery. The main point of entry of these arteries is at the upper outer border of each vesicle. This fact has been emphasized by Barnett, who calls it the vessel pole, and who advises its careful ligation before enucleation of the organ. The veins are similar to the arteries. The nerves are derived from the pelvic plexus of the autonomic system and are present in considerable number. The lymphatics drain into the glands on the common and internal iliac vessels.

**Normal Histology.**—The wall of the seminal vesicle is composed of three layers of smooth muscle fibers; the inner and outer coats running longitudinally, while the middle coat is circular. These enclose many multilocular cavities, lined by high, cylindrical epithelium. The cavities are surrounded by many elastic tissue fibers, and show also in their periphery numerous sympathetic nerve ganglia.

## PHYSIOLOGY.

The prostate is best examined physiologically from three aspects: as a secreting gland, as a muscular organ, and as an organ of special function represented by the great variety of nerve structures within its substance.

**Secretion.**—With the advent of puberty the prostate and seminal vesicles assume an active growth which mostly involves their glandular elements, although there is some general increase in size and amount of the supporting structures. This activity is synchronous with the appearance of spermatozoa; and the combined secretions of the testes, prostate, seminal vesicles, and Cowper's glands constitute the semen. This is a glairy, semimucilaginous fluid, of uneven consistency, giving off a characteristic odor. It is probable that these combined secretory products of the accessory genital glands act to preserve the life and motility of the spermatozoön, though the role played by any individual gland is still quite uncertain. We do know, however, that the seminal vesicles act as reservoirs for the spermatozoa, besides furnishing a secretion to the semen.

From the many and diverse observations on this subject it seems probable that the prostatic and vesicular secretion acts on the spermatozoa in a physical as well as in a specific physiological manner. In

the case of human spermatozoa it has been shown that the duration of their activity outside the body depends in a large measure on the reaction of their surrounding medium. An acid medium slows their motility, or entirely suspends it, while a weakly alkaline one seems most favorable. Analogous results are shown clinically in some cases of chronic prostatitis and vesiculitis, in which, though many spermatozoa are found, they are all without motion. And in such cases their motility is regained on subsidence of the infection. Such findings are best explained by a change in the reaction of the semen caused by the bacterial invasion.

It has further been shown that spermatozoa placed in a physiological salt solution do not live as long as do those in the semen. But the view expressed by Fürbringer,<sup>5</sup> that the prostatic and vesicular secretion causes the spermatozoa, normally motionless, to assume motility, appears at present untenable. For, in man, motile spermatozoa have been found frequently in the fluid of spermatoceles; and in exploratory revision of the epididymis in cases showing sterility, the writer has repeatedly demonstrated motile spermatozoa in the globus major. But though spermatozoa obtained from the epididymis do show motion, it is probable that this is much better maintained in the midst of the normal secretions of the accessory glands.

The physical properties of the semen in respect to its viscosity seem also to play a part, it being well-known that human semen becomes more limpid and homogeneous after standing than when it is first ejaculated, even though the normal temperature is maintained. It is probable that the more fluid portion of the semen, coming from the prostate, has a dissolving action on the globular masses which come from the seminal vesicles. This would tend to facilitate motion in those spermatozoa held in the vesicles.

Attempts have been made to gain light on the physiology of these organs through experimental extirpation in animals, and though it is very unsafe to draw parallel deductions in such a highly specialized biological phenomenon as that of procreation, these experiments seem to be followed by sterility, though potency is retained.

The intimate physiological relation between the prostate and the gonads is well shown in the marked glandular shrinkage following orchidectomy; or if carried out before puberty, in the complete failure of the prostate to take on its adult character.

That the prostate has also an internal secretion—at least in dogs—would seem to be quite well established by the work of Serrallach and Parès.<sup>13</sup> Following a complete prostatectomy these investigators obtained atrophy and diminution in volume of the testes, with suspension of spermatogenesis. In these animals intravenous injection of a glycerin extract of the prostate caused the reappearance of spermatozoa, as did also a subcutaneous graft of prostatic tissue.

**Muscular Apparatus.**—The musculature of the prostate takes part in two physiological functions—those of micturition and of ejaculation. In the latter the seminal vesicles also play a part.

In micturition the internal sphincter of the bladder is brought into play. This group of smooth muscle fibers forms the involuntary portion of the mechanism controlling bladder closure. Between the acts of urination this muscle is in constant tonus. It is still not entirely clear at what moment in the chain of events leading to urination it receives its stimulus to relax, or what the degree of bladder distention must be to call forth this stimulus. Indeed, writers on the physiology of micturition are not at present in entire agreement on the subject. This is a matter, however, which falls outside the scope of the present article. It is important to note only that the sphincter internus is definitely a part of the prostate, and that it is dependent on an efficient connection with its nervous centres for its constant tonus.

The arrangement of the muscle fibers about the prostatic follicles in a circular fashion, while they are longitudinally placed about the ducts, permits forcible and quick extrusion of the contents of the gland at the period of ejaculation. The same is true of the musculature of the seminal vesicles. In certain animals stimulation of the appropriate nerves calls forth a contraction of the vesicle, in which the organ becomes shorter, while at the same time its circumference is narrowed by a wave of constriction beginning at the upper pole and travelling downward. Thus the contents of both prostate and vesicle reach the urethra quickly, where by the direction of the openings of the prostatic and ejaculatory ducts they are intimately mixed.

It has been held by some that the semen is prevented from entering the bladder by a swelling of the verumontanum which takes place before ejaculation occurs. The weight of evidence is against this view, however. Complete closure of the vesical sphincter, which is present during erection, is undoubtedly sufficient to meet this need. That such closure is of considerable intensity is well demonstrated by the unusually marked voluntary efforts which must be made to secure relaxation of the sphincter and subsequent urination in the presence of erection.

**Nerve Supply.**—Much has still to be learned concerning the function of the very complex nervous mechanism of the prostate and seminal vesicles. From the investigations of von Zeissel it would seem that the hypogastrics are the true secretory nerves of these organs. Motor nerves also exist; some in the hypogastrics, some in the nervi erigentes coming from the anterior sacra. The significance of the ganglion cells and of nerves showing special end-organs is entirely unknown, though for the latter it may be surmised that they have to do with the sensual phase of the act of coitus. The importance of the nerve supply in the region of the verumontanum is undoubtedly great, though here again clear-cut data are lacking. Clinically, many abnormalities have been ascribed to inflammation located here, some justly, others without any clear evidence. Diminished sexual sensation, impotence, premature ejaculation, among others, as well as psychic disturbances such as sexual neurasthenia, are sometimes said to be due to lesions of this area. However this may be, it is certain that the nerves situated here play a large part in the sensory side of the act of coition.

## BIBLIOGRAPHY.

1. Aversenq and Dieulafé: Aponévroses et espaces périprostatiques, *Ann. d. mal. d. org. génito-urin.*, 1911, xxix-1, 1.
2. Cosentino: Sulla distribuzione del tessuto elastico nella prostata dell' uomo e degli animali. *Anat. Anz.*, 1905, xxvi, 293.
3. Denonvilliers: Propositions d'anatomie de physiologie et de pathologie. Paris Thésis, 1837.
4. Fischel and Kreibich: Ueber Prostatasekretion, *Wien. klin. Wchnschr.*, 1911, xxiii, 901.
5. Fürbringer: Ueber Prostatafunktion und ihre Beziehung zur Potentia generandi der Männer, *Berl. klin. Wchnschr.*, 1886, xxiii, 476.
6. Luna: Ueber Anordnung und Struktur der sympathischen Ganglien in der menschlichen Prostata, *Folia neurol.*, 1908, ii, 220.
7. Lowsley: Gross Anatomy of the Human Prostate Gland and Contiguous Structures, *Surg., Gynec. and Obst.*, 1915, xx, 183. The Development of the Human Prostate Gland with Reference to the Development of Other Structures at the Neck of the Urinary Bladder, *Am. Jour. Anat.*, 1912, xiii, 299.
8. Müller and Dahl: Die Innervierung der männlichen Geschlechtsorgane, *Deutsch. Arch. f. klin. Med.*, 1912, cvii, 113.
9. Pallin: Beiträge zur Anatomie und Embryologie der Prostata und der Samenblasen, *Arch. f. Anat. u. Physiol.*, 1901, i, 135.
10. Picker: Studien über das Gangsystem der menschlichen Samenblase, Berlin, 1911.
11. Pousson and Desnos: *Encyclopédie française d'urologie*, Paris, 1914, vol. i, O. Doin.
12. Porosz: Daten zur Anatomie der Prostata, *Arch. f. Anat. u. Physiol.*, 1913, Sup. vol., 172.
13. Serrallach and Parès: La sécrétion interne de la prostate, *Ann. d. mal. d. org. génito-urin.*, 1911, xxix-1, 625.
14. Stöhr: Bemerkungen über die Verbindungen der Lymphgefässsystem der Prostata, *Anat. Anz.*, 1899.
15. Timofeew: Ueber ein besondere Art von eingekapselten Nervenendigungen in den männlichen Geschlechtsorganen bei Säugethieren, *Anat. Anz.*, 1896, xi, 44.
16. Voelcker: Chirurgie der Samenblasen, *Neue Deutsch. Chir.*, 1912, ii.
17. Walker: Beiträge zur Anatomie und Physiologie der Prostata neben Bemerkungen über den Vorgang der Ejakulation, *Arch. f. Anat. u. Physiol.*, 1899, 313.
18. Wilson and Magrath: *Surgical Pathology of the Prostate*, *Surg., Gynec. and Obst.*, 1911, xiii, 647.

## CHAPTER XIX.

### PROSTATIC OBSTRUCTIONS.

#### URINARY STASIS DUE TO PRIMARY HYPERPLASIA OF THE ELEMENTAL TISSUES OF THE PROSTATE.

By PAUL MONROE PILCHER, A.M., M.D.

PROSTATIC obstructions have long been recognized as a cause of urinary stasis. The history of its recognition, and of the attempts to remedy the local consequences of its development, goes hand in hand with the gradual growth of our knowledge of anatomy, pathology, and surgical technic. The desperate need of relief in many cases led to the employment at first of crude and cruel means of overcoming the obstruction—at first, forced catheterization and bold tunnelling of the prostate through the urethra—later forcible compression within the prostatic urethra. Occasionally we read of suprapubic puncture and suprapubic and perineal cystotomy in emergency cases.

The history of this subject has been frequently written, but to my mind contains very little of real interest, until the latter half of the 19th Century. Mercier's "prostatectome," devised by him in 1837, was the first instrument employed, which gave promise of permanent relief. Bottini, in 1873, improved this instrument by the use of a galvanocautery incisor. This method of Bottini was extensively tried by various surgeons, and for several years had considerable vogue, but latterly it has been entirely displaced by the more modern surgical procedures.

Many surgeons in the course of their work, involving lesions of the prostate, removed obstructing portions of the gland, but the mortality was so alarming that most men preferred to employ the less radical measures, such as establishing a permanent suprapubic fistula, perineal drainage, partial cautery destruction of the gland, removal of the testicles, vasectomy, etc., all of which met with a certain measure of success. Belfield, in 1887, advocated suprapubic prostatectomy, and in 1888 McGill, of Leeds, published his monograph recommending suprapubic prostatectomy.

Fuller (1895) was the first in this country to work out a satisfactory technic for suprapubic prostatectomy. This method of prostatectomy was not, however, popularly received until the technic of Freyer was published in 1901. His teachings of the after-treatment, which, however, differed from that of Fuller in no essential respect, have been of the greatest importance, and he was the first to show the results of this operation in a large series of cases.

Perineal prostatectomy likewise had been accomplished many times by various men, notably Albarran and Proust in France, but it remained for H. H. Young, of Baltimore, in 1903 to work out a satisfactory technic for its performance. He published a large series of cases operated by this method and showed a remarkably low mortality rate.

There still remained much to be desired. The methods, both suprapubic and perineal, while reasonably safe in the hands of a few experts, when attempted by the general surgeon, as was often necessary, resulted in a relatively high mortality. The combined work of many urologists resulted in the general adoption of a period of preliminary treatment in all cases of urinary stasis. Periodic catheterization, continuous drainage of the bladder, renal decompression, became recognized preliminaries to prostatectomy. Finally the two-stage transvesical prostatectomy, which is an operation that is reasonably safe in the hands of the general surgeon, was established.

### ANATOMY OF THE PROSTATE.

The anatomy of the prostate has been given in detail in a previous chapter, so the details need not be repeated here. Surgically we have come to recognize that the prostate is divisible into five lobes: the two lateral lobes, the middle lobe, the posterior lobe, and the anterior lobe.<sup>6</sup>

The fact is that the prostate is described as divided into lobes only because it consists primarily of five buds jutting out from the posterior urethra. Each bud represents a collection of tubules which later develop into secreting glandular masses which finally fuse and form into a single body called the prostate gland. If one were to attempt division of the normal prostate into lobes basing his judgment on the gross appearance of the gland in its normal state it would be very difficult. Therefore, to my mind, it is of very little moment whether we recognize certain definite subdivisions of the gland, or not, if we but keep in mind the fact that the gland develops from five distinct buds, and we may designate their end-development as we will.

### PATHOLOGY OF THE PROSTATE.

It is unfortunate that a more fitting term has not been universally accepted to designate the general condition of *urinary stasis* due to non-malignant, non-inflammatory changes in the prostate gland. The designation hypertrophy of the prostate is often incorrect, for we frequently see cases in which the gland is not enlarged, and yet the interstitial changes are sufficient to cause obstruction and urinary stasis. I refer to the cases of *muscular and fibrous hyperplasia* and not infrequently cases of *irregular glandular hyperplasia with enlargements*. This chapter dealing with urinary stasis also must include the cases of *hyperplasia of the submucous and subcervical glands* which cause obstruction. To speak of chronic "prostatism" is also incorrect, for such a term would lead us to believe that we were dealing with a chronic

disease of the prostate, in which the pathological conditions in the prostate were giving rise to the symptoms from which the patient is suffering, while in fact the pathological lesion gives rise to no symptoms, as a rule, but acts mechanically, causing urinary stasis which in its turn causes the local symptoms and the more far-reaching systemic disorders. Furthermore, the long-accepted caption "prostatism sans prostate" is a catchy phrase absolutely devoid of scientific meaning and should be discarded.

"Adenomatous hypertrophy" of the prostate is likewise a misnomer. The term *hypertrophy* is erroneously substituted for hyperplasia, or cytoplasia; *adenoma* of the prostate, meaning thereby a neoplasm, is certainly of rare occurrence. Adenoma of the prostate, meaning a benign glandular hyperplasia, is distinctly different from "adenomatous" conditions, and the two terms should not be interchanged. An adenoma is a true neoplasm developing from proliferating glandular tissue. Glandular hyperplasia of the prostate is, unlike adenoma, not a reproduction but a reduplication of cells and acini, and, unlike adenoma, conforms as much in its microscopic as in its gross morphology to the original glandular structure. Glandular hyperplasia of the prostate, which is a multilobular gland, may manifest itself as discreet, nodular tumefactions which are somewhat enucleatable. This is only an expression of the structure of the gland wherein the various anatomical units have undergone hyperplasia and is not to be confounded with adenomata which are rarely multiple.

Excluding syphilis, tuberculosis and cancerous lesions of the prostate, the *non-inflammatory enlargements* of the prostate are either cytological or mechanical, viz.:

1. Cytological hyperplasia  $\left\{ \begin{array}{l} (a) \text{ of the parenchyma.} \\ (b) \text{ of the stroma.} \\ (c) \text{ of both.} \end{array} \right.$
2. Mechanical—due to retention of gland contents with cystic dilatation.

In addition to this we have deformities in and about the prostate due to inflammation and irregularities of development of accessory glands which cause symptoms similar to hypertrophy of the prostate.

*Hyperplasia of the accessory glandular structure, i. e.,* the submucous and subtrigonal glands. These are so closely associated with the prostate that they are often difficult of differentiation. Situated as they are at the outlet of the bladder, hyperplasia of these gland groups causes urinary obstruction just as do the prostatic enlargements.

**Gross Pathology.**—Our understanding of the gross pathology of prostatic obstruction has changed but little in the past ten years. The most interesting contributions have been from Tandler and Zuckerkandl,<sup>12</sup> Lowsley,<sup>7</sup> Wilson and McGrath,<sup>17</sup> and Henry Wade.<sup>14</sup> The chief difference of opinion is in the interpretation of the gross specimens removed. Practically, these differences are of no importance. All agree that the glandular hyperplasia does not affect the entire gland at one time; but usually starts in the median and lateral lobes, and

gradually increasing, presses aside the overlying gland structures, causing their gradual atrophy and surrounding the hyperplastic mass by a false capsule composed of the atrophied shell of prostatic tissue together with fibrous and muscular tissue. Also, a recognition of the fact that a prostate which has not a false capsule of this type is difficult of enucleation. This is true of the cases of fibrous and muscular hyperplasia and the obstructive lesions due to inflammation. Also, there seems to be increasing evidence that the suburethral and sub-trigonal groups of glands which are closely associated with the prostatic gland, become hyperplastic and cause obstruction.



FIG. 240.—Note relation of capsule A, A, to glandular structure; also distortion of the urethra and distribution of glandular and fibromuscular hypertrophy.

Examining the gross specimens we find the large, soft prostate, the small, hard prostate and a mixed type.

The large, soft type is composed of masses of glandular tissue presenting all degrees of change from the normal alveoli to the formation of cysts and large adenomatous-like masses. There is a relative and absolute increase in the amount of glandular tissue and in varying degrees a relative and absolute increase in the amount of fibrous and muscular tissue.

The ducts are in many places dilated and filled with retained secretion, often degenerated epithelium, leukocytes, amylaceous bodies and calculi. These contents may even obstruct the ducts. In the tissue

surrounding the ducts are often seen round cells and polymorpnuclear leukocytes. In some places the ducts are seemingly constricted.

The glands and acini are greatly but unevenly dilated and enlarged. A whole lobule may be enlarged without any dilatation of the acini, presenting the appearance of an adenoma, but differing from it in that

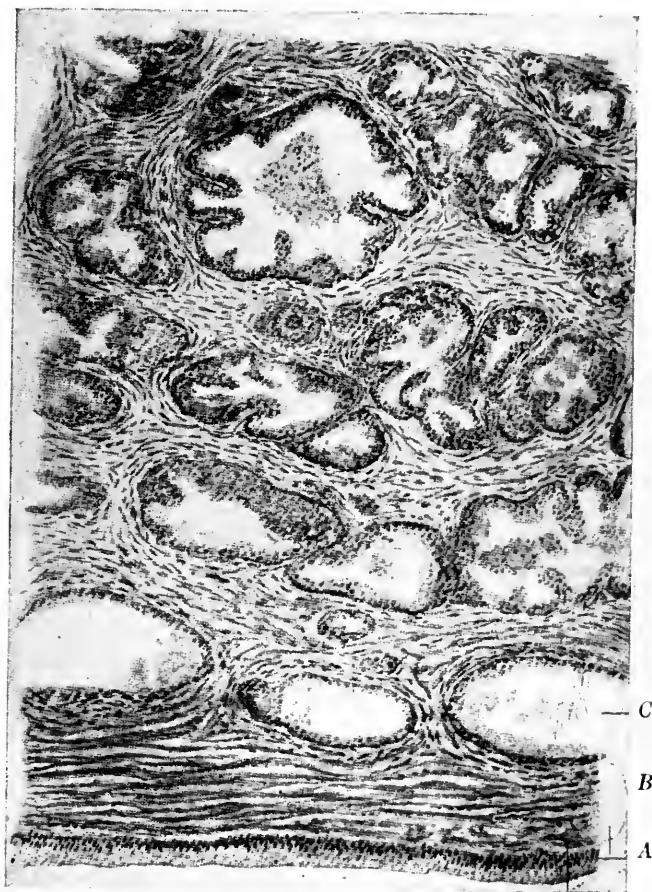


FIG. 241.—Showing relation of the mucosa of the prostatic urethra to the substance of the prostate. Camera lucida drawing from same section as Fig. 240. Note the intimate relation between the epithelial layer, *A*, and the underlying fibromuscular layer, *B*, which is not in any way differentiated from the musculo-glandulo-fibrous layer, *C*, which makes up the bulk of the hypertrophied prostate. In the musculo-fibrous layer, *B*, the muscular elements predominate.

it has a definite, active secretion which is emptied into the urethra by the ducts. A small portion of a lobule or a single acinus may be affected.

My own observations as to the relative change in the amount of muscular tissue in the hypertrophied prostate do not agree entirely

with that of other workers. The two coats surrounding the dilated acini do not show as distinct a differentiation as in the young prostate. From the nature of the glandular change it is natural to suppose that the surrounding tissue will be distorted, but not necessarily changed relatively. It is only when the wall between two adjacent acini becomes thinned down to one or two layers of cells that the muscular fibers disappear (Fig. 242 and 243), and only the connective-tissue framework remains. In fact, in many cases the muscular tissue shows a moderate but true hyperplasia.

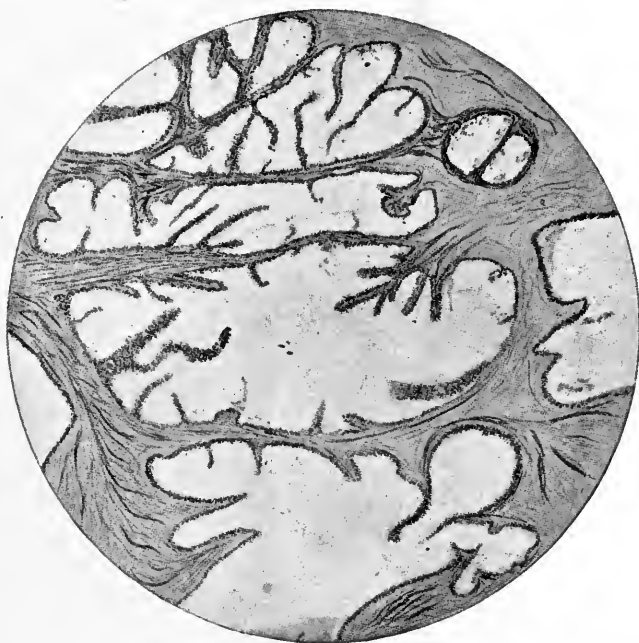


FIG. 242.—Exact drawing from a portion of an hypertrophied and dilated lobule. Showing the thinning out of the musculofibrous stroma. The lighter areas of the stroma represent muscular tissue and the heavier lines connective tissue. In some places the walls separating the acini have disappeared.

The amount of connective tissue varies in different specimens. Most observers claim that it is everywhere increased, but not relatively as much as the glandular tissue. It is true that in many cases the connective tissue is increased relatively, but sometimes the proportion of muscular hyperplasia is almost as great as the connective-tissue increase. Throughout this tissue at different points, varying degrees of round-cell infiltration are to be seen. In some cases arteriosclerosis of an advanced stage is present. In many of our cases there were seen areas of extravasated blood. Again are seen areas of normal tissue.

In the *atrophic* prostates, two forms have been observed: The *first* in which the glandular elements are decreased and smaller than normal. In these prostates the amount of muscular tissue present seems to

exceed the amount of new connective tissue, which in some cases is relatively diminished. In one case the predominance of muscular tissue was very marked. The *second* form presents a combination of compressed glands which predominate, and a few dilated hypertrophied lobules, which, however, never reach any considerable size.

**Concerning the Portions of the Gland Involved.**—Lowsley agrees with the more advanced pathologists and recognizes five lobes in the prostatic mass. The middle lobe is quite independent of the others and its tubules are distinctly separated from the others. They are situated within the gland structure and are in relation with the floor of the



FIG. 243.—Exact drawing from periphery of same lobule as shown in Fig. 242. Showing a sclerosed vessel whose lumen is represented by a single line of endothelial cells, *C*. Note how the vessel wall is separated from the fibromuscular structures of the lobule, just as the fibromuscular capsule of the gland is from the glandular body itself. Small areas of extravasated blood and round-cell infiltrations are seen.

urethra. The posterior lobe is situated farthest from the bladder and is almost an independent structure. It is, further, of interest to note that the tubules of the middle lobe lie side by side with those of the lateral lobes, but at no point do they intermingle. The lateral lobes are made up of a series of tubules on each side of the urethra and the acini of these lobes form the main mass of the gland. It is distinctly indicated that the lateral lobes are in direct relation with the urethra. The posterior lobe seems to be almost an independent structure and is seldom involved in hypertrophy of the gland. It, however, seems to be a starting-point for malignant degeneration in many cases.

The theories of Tandler and Zuckerkandl demand careful study. They hold that in all cases of prostatic hypertrophy the glandular



FIG. 244.—Sagittal view of a wax model of the prostate of a newborn infant.  $\times 14$ . (From Lowsley.) *Lat.*, anterior branches of lateral lobes; *P.L.*, posterior lobe; *E.J.*, ejaculatory duct; *S.V.*, seminal vesicle; *A.L.*, anterior lobe tubule; *U.*, urethra; *U.P.*, utriculus prostaticus; *A.G.*, subcervical glands of Albarran; *M.L.*, middle lobe tubules; *L.Ur.*, left ureter; *Bl.*, bladder; *P.Gl.*, prostate gland.

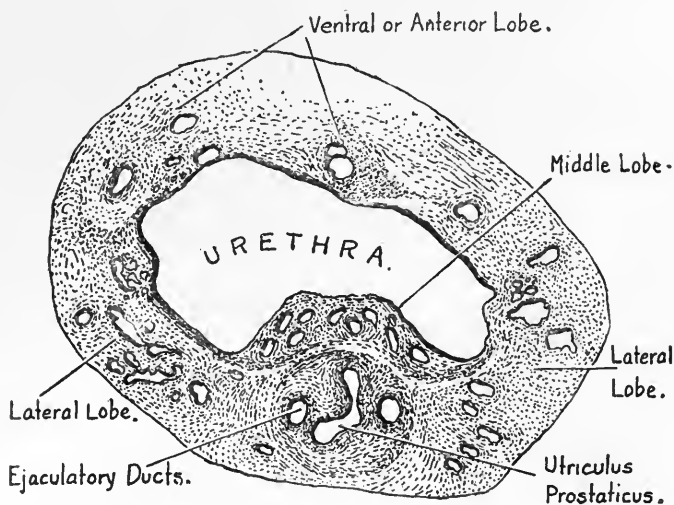


FIG. 245.—Cross-section through middle lobe of prostate. (Lowsley.)

hyperplasia starts in the middle lobe; in other words, the gland group which buds from the floor of the urethra is the starting-point of the

obstruction and it extends upward into the bladder and laterally around the urethra. The extended observations of other pathologists do not, however, confirm this. All are agreed that the posterior lobe does not share in the hyperplasia.

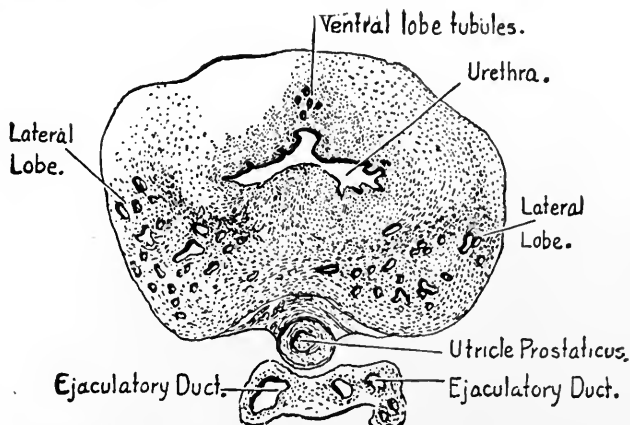


FIG. 246.—Cross-section through prostate and the ejaculation ducts below. (Lowsley.)

If enlargement of the median lobe takes place, it must proceed along the avenue of least resistance, which is through the vesical outlet, gradually dilating it and forcing the sphincter ring wide open. That

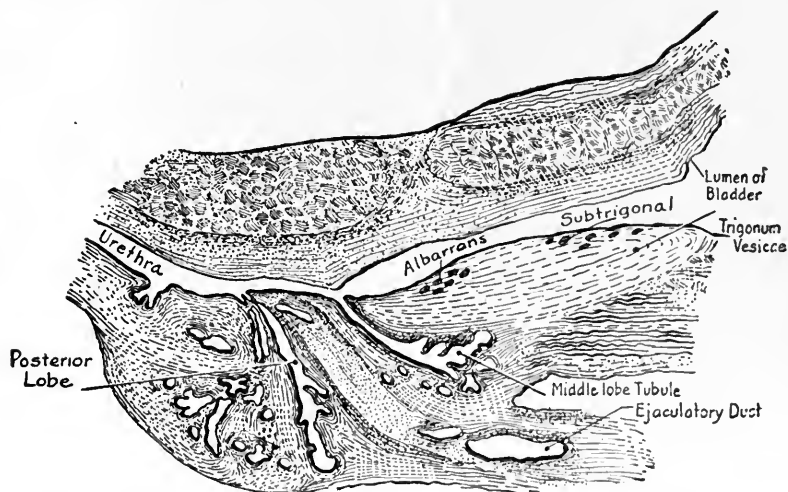


FIG. 247.—Longitudinal section through neck of bladder, prostate and posterior urethra. (Lowsley.)

this frequently occurs is well shown by many specimens. However, it is hard to accept the theory that in some, or in many cases, the enlargement of the median lobe takes place in the direction of the lateral lobes, displacing them and causing atrophy of these lobes, compressing

them out into a shell-like capsule; to produce a lateral extension of an enlarging median lobe, the expansion must take place, not along the avenue of least resistance, but against a firm, well-developed structure. Judging from the anatomical relations as found on the operating table, Tandler's conclusions as to the part of the prostate involved in the obstruction are incorrect.

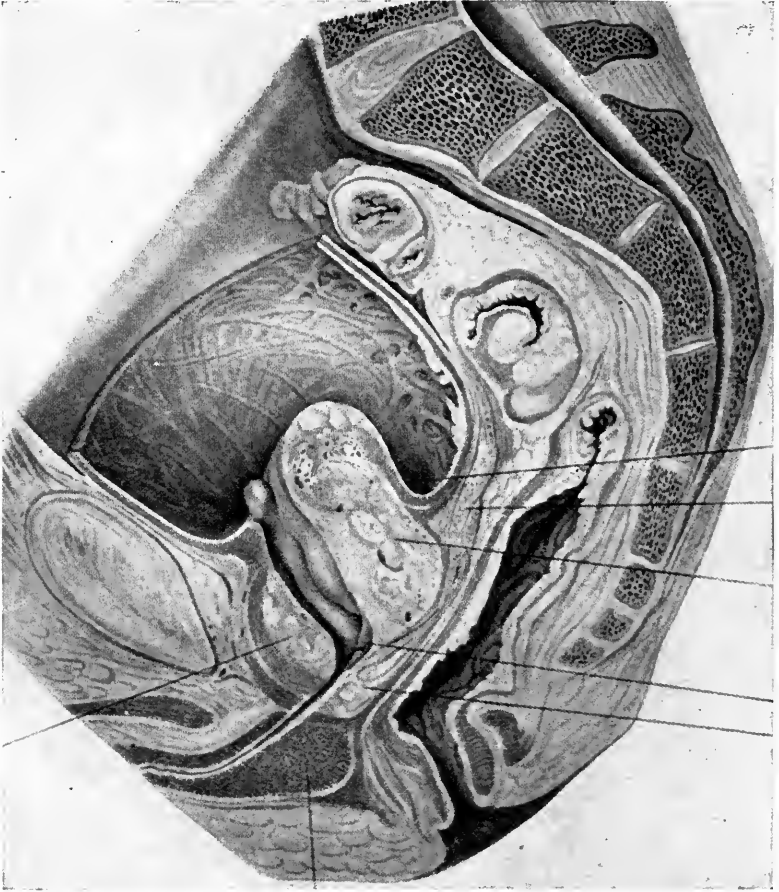


FIG. 248.—Sagittal section through the pelvis, showing the prostate hypertrophied. (Tandler and Zuckerkandl.)

Fig. 248 is an illustration taken from the work of Tandler and Zuckerkandl, showing a sagittal section of the pelvis in a case of prostatic hypertrophy. We agree that this represents a typical case of median lobe enlargement. A number of other illustrations which are shown in the work of Tandler and Zuckerkandl are unquestionably examples of median lobe enlargement, for in each the hyperplastic mass is more or less symmetrical in the median line and is forced through the

sphincter dilating it. The same phenomenon has been plainly shown in many of our own specimens. For example, Figs. 249, 250 and 251. At the same time the enlargement of the lateral lobes without the median lobe enlargement may take place, and in such cases the sphincter is greatly dilated and surrounds the hyperplastic mass. Such a case is seen in Fig. 252. In this case the lateral lobes have become enormously hypertrophied and have carried the median lobe, which is also enlarged, through the sphincter well into the bladder. It cannot be conceived that, after the enucleation which was accomplished in this case, much prostatic tissue was left behind, unless it was the posterior lobe which is so nearly independent. Fig. 253, however, shows a different condition.

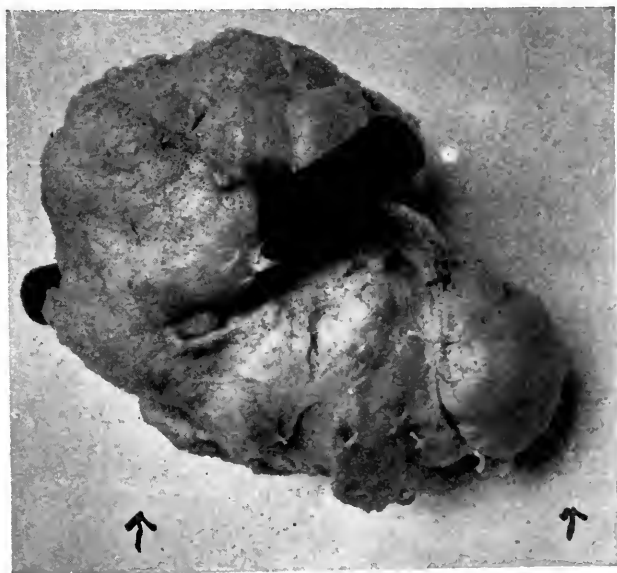


FIG. 249.—Prostatic mass removed by transvesical operation, rubber tube showing direction of urethra. Beneath the rubber tube is a greatly hypertrophied middle lobe. The lateral lobes are seen forming the sides and roof of the urethra, but are not in any way obstructive.

This was a case of complete urinary obstruction which had lasted for three years. *B'*, *B'*, are the enlarged lateral lobes. *B* is a greatly hypertrophied median lobe. *A* is a crescent-shaped calculus, and the remaining pieces of tissue are compressed and atrophied bits of prostatic tissue which still remained imbedded in the capsule of the prostate after the hyperplastic masses had been enucleated. Fig. 254 is an example of symmetrical enlargement of the median and both lateral lobes. Fig. 255 is an example of bilateral hypertrophy without any median lobe enlargement. The specimen is very distinct and convincing on this point. Fig. 256 is another example of irregular hypertrophy of the lateral lobe with very little median lobe enlargement. Fig. 257

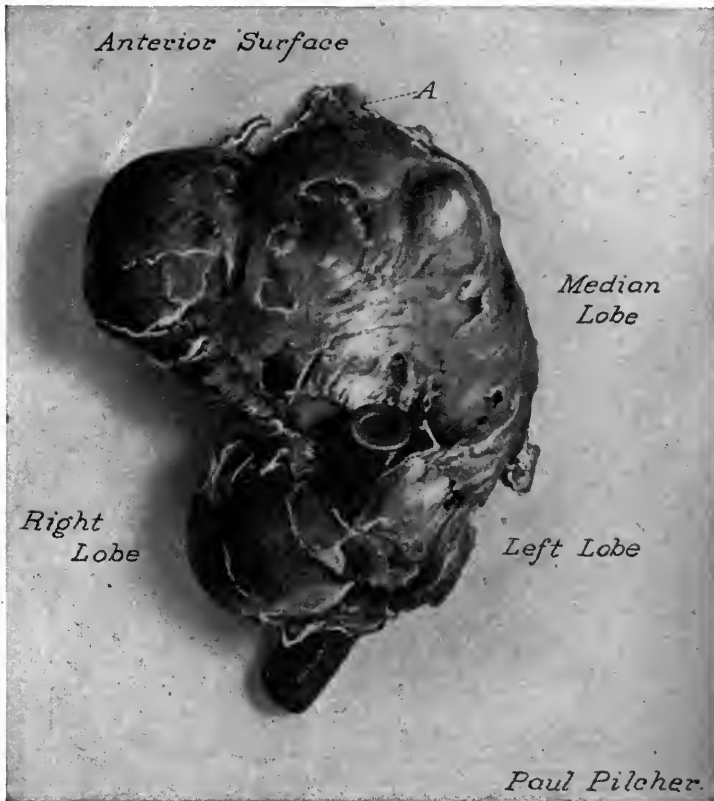


FIG. 250.—Enormous median lobe enlargement of the prostate with adenomatous changes in the lateral lobes. These lobes are smaller than normal and show no atrophy due to pressure. The specimen presents a view of the anterior face. The part above the rubber tube was entirely intravesical. The anterior face is covered by mucous membrane.

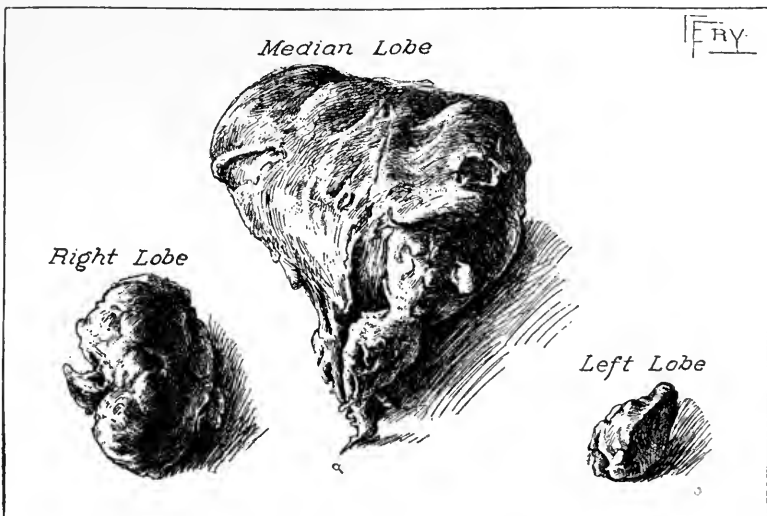


FIG. 251.—Drawing showing the three lobes of the prostate separated. Same specimen as Fig. 250.

shows a specimen removed in one piece in which the median lobe is enlarged and has pushed forward into the bladder and distorts the urethra, lifting it up and making it almost impossible to empty the bladder. The position of the sphincter is indicated by the arrows. Fig. 258 shows still another type of development. The lateral lobes in this case had been previously removed by perineal operation. The symptoms persisted and three years later this median lobe enlargement, with a very freely movable ball-valve attachment, was taken out by a transvesical operation. No remnants of the lateral lobes could be found. It is interesting to note the position of the internal sphincter as indicated by the arrows. In this case we had the obstruction of the enlarged mass and in addition a ball-valve action.

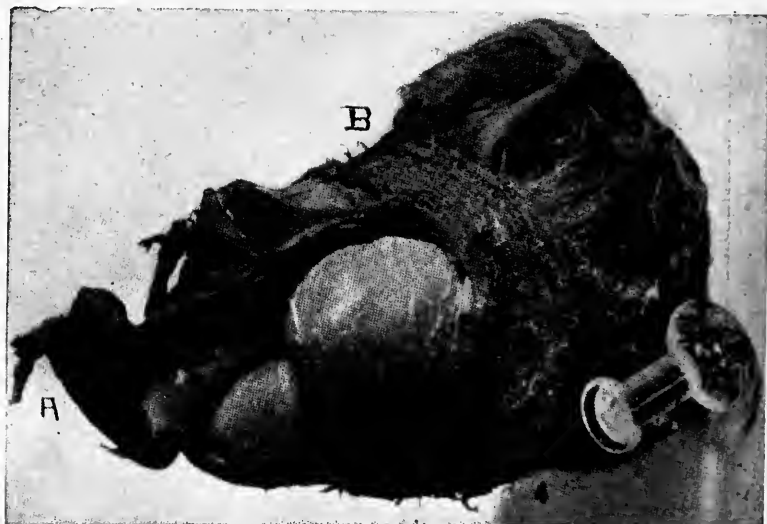


FIG. 252.—Photograph of hypertrophied prostate removed by suprapubic route, showing bilateral and median enlargement. At vesical pole, A, the capsule and mucous membrane of the bladder are shown stripped back from the glandular portion of the gland. At B is seen the circular capsule which passes entirely around the gland.

Fig. 260 is the photograph of a specimen, actual size, removed in one piece. It is a perfect example of enlargements of both lateral lobes of the prostate. Fig. 259 shows a section through the centre of this mass and shows quite distinctly the three lobes, the two lateral lobes and the median lobe, and their position in relation to the urethra. The median lobe extends upward like a wedge between the two lateral lobes and is only moderately enlarged. In this connection reference may be made to the series of photographs of specimens which were published in 1888 by Francis S. Watson, of Boston, in his treatise on the *Operative Treatment of Hypertrophy of the Prostate*. Fig. 261 shows very important feature; the lateral lobes are moderately enlarged, the median lobe is distinctly enlarged and is projecting into the bladder,



FIG. 253.—Photograph of prostatic masses removed by transvesical route. *A* is a crescent-shaped calculus; *B*, a large median lobe; *B'*, *B'* the two lateral lobes. The other pieces of tissue shown in the specimen are atrophied prostate tissue adherent to the capsule.

forming the cause of the obstruction. Distal to the median lobe enlargement is seen a raised-up portion, which is the colliculus or verumontanum, at which point the vasa deferentia empties into the

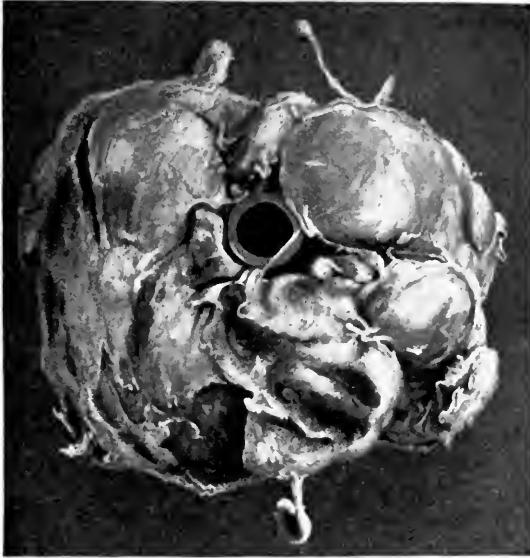


FIG. 254.—Specimen removed by transvesical operation, showing symmetrical enlargement of both median and lateral lobes.

urethra. If the finger is introduced into the urethra by the transvesical route in enucleating the prostate, one can easily see from the specimen

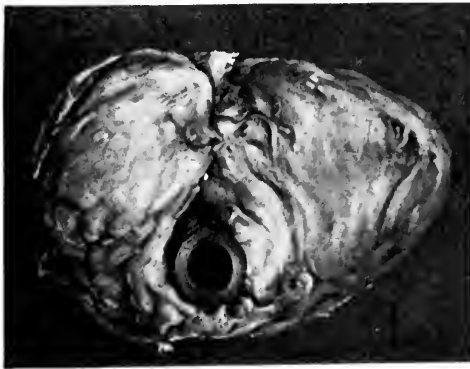


FIG. 255.—Specimen removed by transvesical operation, showing hypertrophy of lateral lobes without involvement of median lobes.

how the colliculus may be preserved. Fig. 262 is an undeniable example of enlargement of both the lateral and median lobes of the prostate. This specimen which is a dissection not only of the prostate but of the

bladder as well, shows exactly the relation which no drawing could so well express. The tortuous course of the urethra, the presence of the colliculus and its relative position are clearly shown. No one could

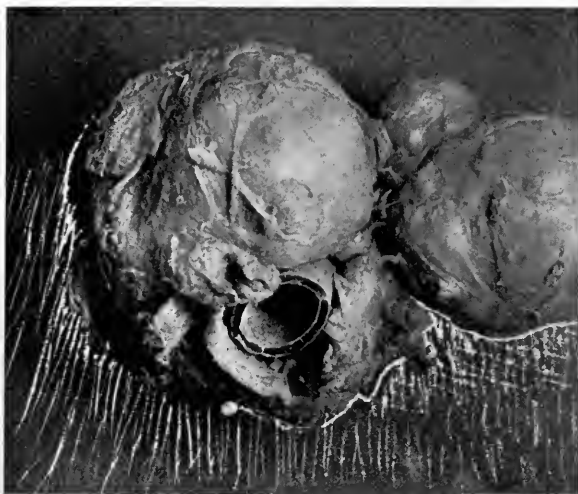


FIG. 256.—Specimen removed by transvesical operation, showing irregular hypertrophy of the lateral lobes with very little median-lobe enlargement.

argue that in these specimens such an hypertrophy originates from the median lobe alone. The floor of the urethra is very clearly shown and is seen to be free from all hypertrophied tissue. This portion of the urethra must invariably be involved, at least that portion between the colliculus and the sphincter, in all median-lobe enlargements. Fig. 263



FIG. 257.—Specimen removed by transvesical operation, showing marked median-lobe enlargement with practically no lateral-lobe enlargement.

is a perfect example of median-lobe enlargement alone. In this case the lateral lobes are distinct, but not hypertrophied. The specimen shown in Fig. 264 shows well the part taken by the lateral lobes in some

cases of obstructive prostatic overgrowth. The specimen was removed by the transvesical route, and the entire deformed portion of the pros-



FIG. 258.—Median-lobe enlargement with ball-valve attachment.

tate was removed in one piece. Fig. 265 shows the under surface of this prostatic mass. A rubber tube passing through the specimen indi-

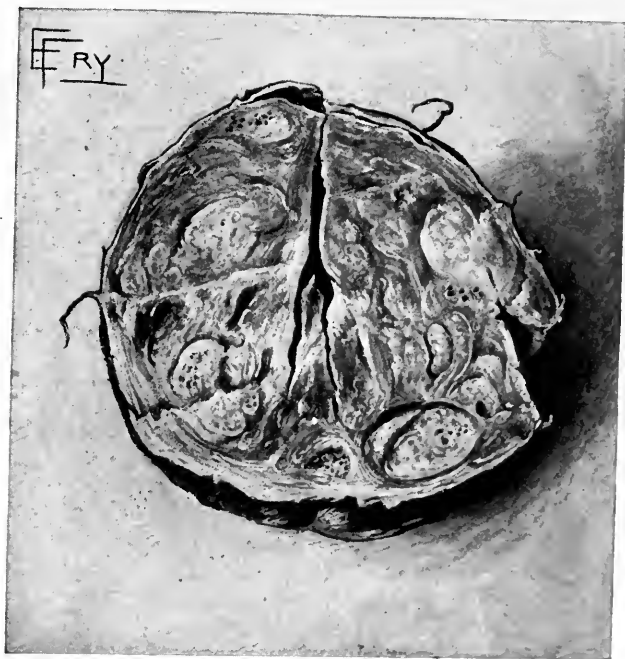


FIG. 259.—Cross-section of specimen shown in Fig. 260 showing relation of median lobe and two lateral lobes to the urethra.

cates the position of the urethra. At the top of the specimen is seen a small collar which is the mucous membrane stripped up from the

internal sphincter. This sphincter could be appreciated by a finger in the bladder. Fig. 266 is another photograph of this same specimen viewed from the anterior surface, showing, roughly, the course of the urethra, as exaggerated by the furrows produced by the presence of the rubber tube in the hardened specimen. The two lateral lobes which appear like the wings of a butterfly are joined across the median line by a practically normal median lobe which is not enlarged. The collar of mucous membrane also appears at the top of this specimen and shows

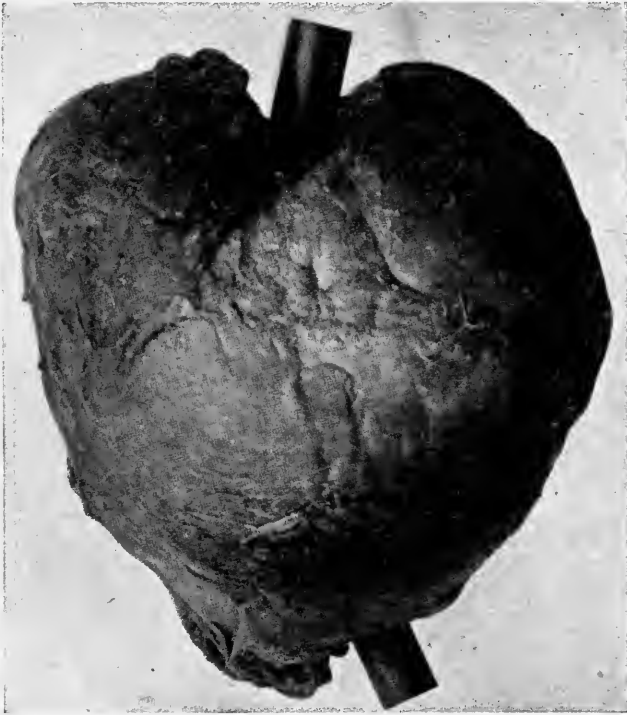


FIG. 260.—Enlargement of the prostate in which the two lateral lobes are involved. The vesical surface of the prostate appears at the top of the picture. This specimen was removed within its capsule and is a perfect example of coincident hypertrophy of both lateral lobes without any marked median-lobe enlargement. The section through this mass is seen in the preceding figure which shows the narrow cleft occupied by the urethra. The two lateral masses and the small adenomatous median lobe are seen.

the lack of any bulging in the bladder. As far as could be appreciated by the finger, the entire prostate was removed in this case with the possible exception of the posterior lobe of the gland which was distal to the ducts, but the remains of which could not be appreciated by the finger. Fig. 267 is a photograph of a specimen which shows the prostatic mass as removed in one piece. The small drainage tube occupies the position of the distorted urethra and shows the presence of the greatly enlarged median lobe which extends into the bladder and

lifts up the urethra. The bladder in this case is to the right of the specimen. As one views the gross specimen, it would look as if the entire mass was one piece. When, however, the anterior commissure is divided, the specimen falls apart and forms three distinct portions; the two lateral masses, which are the lateral lobes, are greatly enlarged and compress the urethra, the course of which is indicated by the furrow

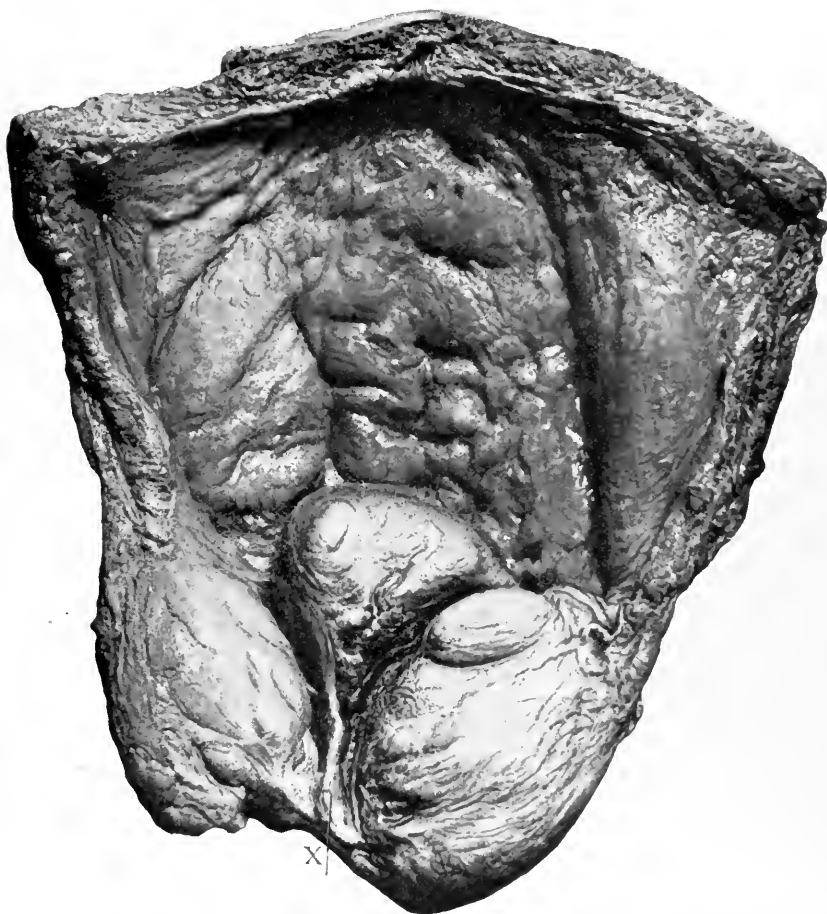


FIG. 261.—Hypertrophy of both lateral and the median lobes. The Y-shape taken by the prostatic urethra as it passes on either side the median enlargement to enter the bladder is well shown. Reduced  $\frac{1}{3}$ . (Watson.)

(Fig. 268). To the left, in the upper quadrant of the picture, is seen the median lobe which extends well down into the urethra, well past the first portion of the lateral lobes, in fact, forming a wedge-shaped lobe between the portions of the lateral lobes which extend into the bladder. However, the specimen clearly shows the relations of the two lateral lobes to the urethra. Fig. 268 shows another view of this same gland

which indicates more clearly the exact position of the urethra and its relations to the lateral lobes and to the median lobe. In this specimen



FIG. 262.—Bilateral hypertrophy. The two lateral lobes joined by a bridge or median bar, the so-called bar at the neck of the bladder. Reduced  $\frac{1}{4}$ . (Watson.)

one lateral lobe has been removed and the furrow, as indicated in the specimen, shows the relation of the urethra to both the lateral and median lobes. The lateral lobe forms the side wall for over two inches, while the median lobe passing beneath the urethra extends along it for an inch and a quarter.



FIG. 263.—Hypertrophy of median lobe only. (Watson.)



FIG. 264.—Specimen removed by transvesical operation, showing the entire prostate removed in one piece.

Our own deductions are based primarily on an analytical study of our own cases, taking into account first, the conformation of the prostatic



FIG. 265.—Same specimen as Fig. 264. The anterior commissure divided, allowing the hypertrophied right lobe to drop down, showing the relation of the enlarged middle lobe and the left lateral lobe to the urethra. The middle lobe is seen to form the floor of the urethra for a distance of about  $1\frac{1}{2}$  inches, but does not extend as far up on the urethra as the lateral lobe.



FIG. 266.—Same specimen. Shows this same condition more clearly.

mass as presented to the cystoscopist and judged by the eye, and the mass as found *in situ* at the time of operation and appreciated by the

finger; second, a careful determination of the prostatic mass in relation to the opening of the urethra and the sphincter vesicæ; and third, a thorough gross and sectional examination of all our specimens after removal by the transvesical route.



FIG. 267.—Specimen removed by transvesical operation, showing under surface in a case of enlargement of both lateral lobes.



FIG. 268.—Same specimen as Fig. 267. The anterior commissure divided, showing two lateral hypertrophied lobes and the normal-sized median lobe joining the two enlarged lobes.

#### ENLARGEMENT OF PROSTATE.

**Occurrence.**—In any large series of cases of prostatic enlargements about 80 per cent. will be found to be due to non-malignant hyper-

plasia of the gland elements. We seldom find true enlargements of the prostate in men under fifty years of age, the majority of cases coming to the surgeon for treatment between the ages of sixty and seventy-five years. Various estimates have been made as to the frequency of enlargements of the prostate, the consensus of opinion being that it occurs in about 30 to 35 per cent. of all males over sixty years of age. It is impossible to say how many of these have obstructive symptoms.

The most frequent form of enlargement is the large, soft type which is produced by a hyperplasia of both the parenchyma and the stroma.

Hypertrophy due to hyperplasia of the stroma alone occurs in about 5 per cent. of the cases, and in the Mayo series 20 per cent. of the cases showed an increase in the parenchyma without apparent increase of the stroma.

**Etiology.**—Concerning this we know very little. All are agreed that the true hyperplasia of the gland elements is not the result of inflammation. On the other hand, it is the writer's belief that many of the deformities of the prostate where there is no true cytoplasia are the results of inflammation.

From a study of many prostates it has seemed to us that in the majority of cases the enlargements were due more to glandular overgrowth, distorted and increased by the degenerative changes of old age, than to the influence of any extrinsic inflammatory agency constricting the ducts and causing their dilatation. The question may be asked why this does not take place in all cases. That is as difficult to answer as it is to explain why fibroids, myomata and adenomata develop in the uterus of one woman and not in that of another. We believe that it is not necessarily the length of functional activity of the gland and the age of the individual which cause this change, but that it is a glandular overgrowth influenced by the degenerative changes of old age in an actively functioning gland which produces the change. A previous gonorrheal infection, or any other inflammatory process, may influence the development of the disease.

It is but fair to suppose, too, that other causes may influence this overgrowth. Excessive venery, overindulgence in alcohol, masturbation, protracted habit of withdrawal, sexual excesses, perverted indulgences, horseback riding, long-continued sedentary habits, constipation and climatic exposures, all may be considered as possible contributing etiological factors.

*Changes in the Urethra.*—The prostatic urethra is distorted, depending upon the size, direction and extent of the hypertrophy. It affects that portion of the urethra between the verumontanum and the orifice of the bladder. It is elongated and compressed, its plane depressed downward and backward, and it frequently is tortuous. When the lateral lobes are greatly enlarged the urethra appears as a mere cleft between the two lobes (Fig. 269). The internal orifice of the urethra may assume almost any form, depending on the character of the enlarge-

ments. The mucous membrane of the urethra is intimately related to the gland itself and can only be separated from it with difficulty. (Fig. 270.)



FIG. 269.—Horizontal section of prostate removed by suprapubic prostatectomy, “total” enucleation showing carcinoma along with chronic lobular prostatitis (prostatic hypertrophy), and portion of prostatic sinus adherent. (Wade.)

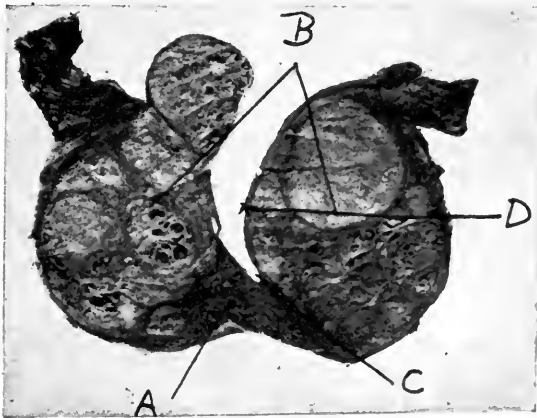


FIG. 270.—Showing intimate relation between urethral mucous membrane and gland.

*Secondary Changes in the Urinary Organs.*—These are due primarily to obstruction at the outlet of the bladder and later to infection.

Deformity at the outlet of the bladder involving also the trigonum corresponds to the extent and direction of the hypertrophy of the prostate. As a rule the gland enlarges, forces its way through the sphincter vesicæ, gradually dilating it. In the cases of massively hypertrophied gland the sphincter is so widely dilated that it becomes functionless. At the same time the urethral orifice is raised, being displaced by the enlarging gland. Its form depends upon the character of the glandular hyperplasia, especially the size and shape of the middle lobe.

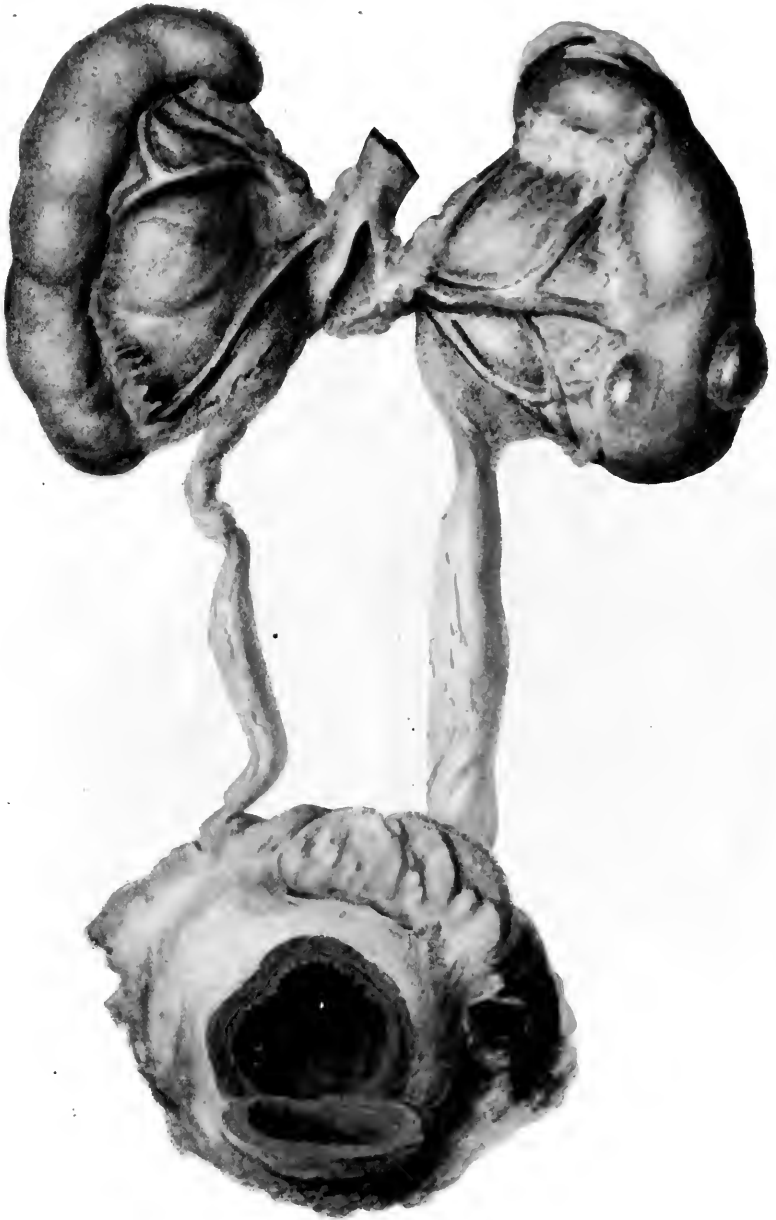
In the cases where the prostate is small and fibrous the orifice is displaced less, but the opening is much less flexible, as is true also of the cases of bar formation. In all of these cases the orifice is held high up and the trigonum drops down nearly vertically, so that the bladder tends to sag at this point and form a so-called pouch below the level of the orifice, which makes it difficult to entirely empty the bladder. The increasing obstruction in the urethra, the lack of flexibility of the sphincter, the unnatural high position of the orifice and the sagging posterior wall of the bladder, all favor incomplete emptying of the bladder which gradually results in urinary stasis of varying degrees, influenced by the changing condition of the prostate. Retention of urine produces its own train of symptoms and, as the amount increases, the pathological changes extend, affecting the bladder itself, the ureters, the kidney and finally the general system. (Plate VII.)

*The bladder* is affected first. The obstruction to the outflow of urine is partially compensated for by an increase in the thickness and strength of the muscular walls. The muscle bands increase very markedly in size and, as the obstruction increases, the individual muscle columns hypertrophy to such an extent that they stand out on the inner wall of the bladder, forming an interlacing network of bands or trabeculations. As the obstruction increases and the force exerted continues, the section of the bladder wall between the muscle bands bulges and numerous false diverticula are produced. The ureter openings are usually not affected until a late stage of the disease. With the incidence of infection, the mucous membrane becomes inflamed, mucus and phosphatic material deposits between the trabeculæ and calculi form. In our own series calculi were found in about 20 per cent. of the cases. If the cystitis is of long standing, the inflammation extends more deeply into the bladder wall and further impairs its utility.

The ureters and finally the kidneys gradually become affected, first from mechanical obstruction and second through infection.

Aside from the clinical evidence of renal infection and renal insufficiency, the most striking evidence of renal injury due to prostatic obstruction is presented in those patients dying from the disease. Autopsy shows a variety of conditions existing in the kidney, the lesion most common to all being a dilatation of the ureter beginning immediately above the bladder, resulting in various degrees of hydro-ureter and hydronephrosis and destruction of the kidney parenchyma. This in turn is influenced by the degree and duration of the obstruction and in more advanced cases is accompanied by infection, formation of renal

PLATE VII



Extreme Backward Pressure Produced by Prostatic Hypertrophy.

Note extreme dilatation of both ureters and renal pelves and extreme atrophy of renal secreting tissue. (Wade.)



calculi, and in some by actual infection and destruction of the kidney parenchyma.

**Urinary Obstruction without Enlargement of the Prostate.**—This subject should occupy a chapter by itself, but is so closely allied with the subject of enlargements of the prostate that it must be mentioned here. We recognize a number of lesions entirely distinct in etiology and histological formation.

**First Type.**—A submucous fibrosis. The most prominent change found, according to Young, is the occurrence of a newly formed connective-tissue layer immediately beneath the mucous membrane, forming a firm *fibrous ring* associated with an elevation of the median portion of the prostate. There is no underlying prostatitis, no infiltration of the sphincter muscle, or hyperplasia of gland tissue. It is essentially a *submucous fibrosis*.

**Second Type.**—Hardly less frequent are those cases of deformed orifice due to chronic inflammatory change in the glandular tissue with round-cell infiltration occasionally extending into the muscle. This is undoubtedly due to previous prostatitis.

**Third Type.**—That due to hypertrophy, or proliferation of the sub-urethral or subtrigonal group of gland acini. This produces retention by mechanical obstruction precisely as do enlargements of the prostate.

**Symptoms.**—The most characteristic symptom of obstructive prostatic disease is the gradual development of frequent urination, with a gradually increasing urgency of urination, and in many cases an increase in the amount of urine passed.

Around these symptoms are grouped various classes of cases which may be described as different types, nearly all of which either early in the disease, or later, present the symptom of frequency of urination as its most prominent feature.

It has been the writer's experience that the particular symptom-complex is not dependent upon any one form of prostatic enlargement. Naturally, the symptoms are dependent upon the degree of pathological change present along the urogenital tract. Nephritis, pyelonephritis, stone in the kidney, ureter, or bladder, purulent cystitis, diverticulitis, increasing degrees of residual urine, all influence the symptom-complex. Stone in the bladder especially affects the symptoms, for its presence causes a congestion and pseudo-enlargement of the prostate, the obstruction, however, decreasing upon the removal of the stone.

The primary symptoms are due chiefly to the obstruction to urination caused by the changes in and about the prostate, and in addition to congestion of the mucous membrane and morphological irregularities in the prostatic portion of the urethra. Frequency and urgency of urination are dependent on these factors, while the symptoms of painful urination and distress after urinating usually are associated with inflammatory conditions of the prostate and the more infrequent forms of obstruction due to fibrous hyperplasia.

The usual story is that of increasing frequency of urination, first noticed at night; later a certain amount of urgency when the desire to

urinate is present; slight difficulty in starting the stream, some diminution in the force and size of the stream as it is ejected; a certain amount of distress in the perineum; also, under stress of nervous excitement, or after exposure to cold, there is often a marked inability to urinate voluntarily, and the impossibility of checking the stream as quickly and fully as was formerly possible. The symptoms are quite irregular as a rule, there being periods of well-being during which time the patient does not notice anything unusual other than the slight increased frequency of urination, and again, the symptoms will be increased by various indiscretions of diet or exercise, and there will exist considerable difficulty in urinating and a sense of pressure and incomplete evacuation of the bladder with more or less continued desire to urinate after the act has been completed. Even in the early stage we may have a period of temporary complete retention of urine coming on after undue exposure. This may last for a few days and then pass off entirely. If the obstruction is due to an irregular form of enlargement, such as a submucous fibrosis or small nodular hyperplasia, with only partial obstruction of the canal, we usually have in addition to the ordinary symptoms vague pains referred to the perineum, to the back and to the legs, and in addition painful urination. If at any time a catheter is used, infection may take place and the entire picture may change to one of cystitis with urinary stasis. Later in the early stage there may be enuresis and slight dribbling of urine during the day. At a later period in the development of the enlargement the symptoms are mostly those of obstruction and pressure, with the symptoms localized in the bladder and urethra. It is a period of incomplete chronic retention. The bladder at no time is entirely empty unless a catheter is passed. The urine frequently does not change its character except in the lowering of the specific gravity and an increase in the actual amount of the urine passed. The symptoms here are variable, depending upon the amount of dilatation of the bladder. There is an increase in the dysuria, the urinary stream is smaller and it may even decrease in size until the patient urinates intermittently in very small amounts. Dull pain in the bladder region extending downward to the legs is frequently complained of at this stage of the disease. There is some difficulty at stool and the patient begins to strain and exert considerable muscular effort to empty his bladder. During this period of mechanical obstruction, calculi frequently form in the bladder. In our own series of cases it occurred in about 20 per cent. of the cases. The calculus tends to increase the disturbing symptoms and invites infection. At this time also, secondary changes begin to take place in the kidney and the reflex disturbances make their appearance, especially those of the gastro-intestinal tract. Hematuria may occur at any time, but is evidence of either a complication or an advanced stage of hyperplasia. The kidney becomes more and more affected by the chronic retention and expresses itself in an increased secretion of urine of a low specific gravity. In addition, changes in the stability of the renal function become evident.

The patient's general condition begins to suffer markedly. There are evidences of loss of sleep, the loss of appetite, lack of food and increasing mental unbalance resulting in a condition of chronic invalidism. The patient becomes an object of pity, his linen is saturated with urine and he always carries with him the unmistakable odor of decomposing urine. Gradually as time goes on his entire attention is given to emptying his bladder. If the case still remains untreated, the patient passes on to a stage of chronic complete retention of urine with a guttatum overflow. The constant straining often produces inguinal herniæ, hemorrhoids and prolapsus ani. Efforts to empty the bladder become more and more ineffectual and the use of a catheter is resorted to. Sooner or later cystitis develops which adds its distressing symptoms. Later the ureters and kidneys share in the infection and death results.

The complications and sequellæ of infection and calculus formation along the urinary tract are the same in their terminal stage, whether due to prostatic obstruction or to other obstruction in the urethra, or at the neck of the bladder.

It is impossible to give a complete word picture of the symptomatology of this disease because of the diversity of the pathological changes which take place. For example, some patients will present symptoms of the early stages of the disease and remain without change for years, while other patients will rapidly pass from one stage to the other and unless properly treated will find their lives intolerable in a short period of time. It is well known, also, that some men will go about suffering from a chronic overdistention of the bladder without ever having suffered urinary symptoms to call their attention to the fact.

The main features, however, are the same. That is, the gradual development of an obstruction at the outlet of the bladder, causing incomplete evacuation of the urine, resulting in far-reaching pathological changes, and terminating in death from uremia or sepsis.

**Diagnosis.—History.**—It is important in every case to take a complete history of the patient. This includes the usual data concerning the early life and habits of the patient, as well as a detailed record of the diseases and accidents suffered by him. The special points worthy of note in all patients suffering from urinary disturbances have already been stated in previous chapters. In these cases we wish to know first the age of the patient, his social status, his venereal history and whether or not he has at any time suffered from infection of the kidney or bladder, has passed calculi, or has been subject to attacks of renal colic. We should ascertain, if possible, whether pus or blood has ever been found in his urine. It is especially important to know if there have ever been any periods when he was unable to voluntarily evacuate his bladder. If so, has it been necessary to pass sounds or catheters to withdraw the urine? In fact, it is always best to obtain all the data possible concerning the urinary organs of the patient previous to his present trouble.

Next, it is important to question the patient concerning the development of the disorder for which he seeks relief. The duration of his symptoms, the order of their occurrence, the extent of the disability resulting, and the effect upon other organs and systems of the body. Usually the patient's attention will centre about the act of urination, the increasing frequency at night and during the day, the difficulty of starting the stream, the smallness of the stream and the lack of force in ejecting it, and the soiling of his linen afterward. Such a history given by a man of advanced years immediately makes one think that he is suffering from obstructive enlargement of the prostate. There are, however a number of other pathological lesions which may give rise to these same symptoms. Therefore a detailed history should be taken and a careful examination of the patient made.



The soft-rubber catheter.



Mercier coudé catheter.



Mercier bicoudé catheter.



Bougie catheters.

FIG. 271.—Various forms of catheters.

**Examination.**—A general physical examination of the patient should first be made. It is unnecessary to reiterate the details of this procedure, but special care should be directed to the condition of the lungs and heart and the general arterial and venous systems. It is important to know the condition of the heart muscle and the condition of the walls of the arteries; and in addition, to record the blood-pressure. An examination of the blood should be made to ascertain the percentage of hemoglobin which is present, and to determine when possible, the blood urea and blood creatinin content as an index of the renal efficiency.

A detailed examination of the abdomen should be made, noting especially the condition of the stomach and intestines, palpating for tumors, and percussing for the bladder, if it is distended. Frequently the examiner will note the presence of inguinal hernie.

Next, the legs are examined, searching especially for edema and varicosities.

With a knowledge of the general condition of the patient, the physician then turns to an examination of the urethra and bladder. At this point a divergence of opinion arises. The expert in urethral catheterism needs no advice. The ordinary physician is advised to use the instruments which can do the least harm. The writer has devised for his own use a metal instrument with a short beak, number 18 of the French scale in size, with a well-curved smooth beak, fitted with an electric lamp and observation telescope, which he uses to explore the urethra and observe the interior of the bladder, and study the conformation of the prostate. With this simple instrument he sounds the urethra, determines the presence of residual urine, and obtains all the information necessary in the majority of cases. The technic for using this instrument is given later. If one is not experienced in the use of a cystoscope, it is wiser to employ the older methods of diagnosis, preferably a medium-sized soft-rubber catheter, or, if this cannot be passed, a Mercier coudé catheter which is stiffer and is especially molded so that the end tends to pass up over the obstructing prostate and enters the bladder. If one is not successful with the Mercier coudé catheter, the bicoudé or the bougie catheters should be tried (Fig. 271).

Another useful instrument is the well-curved metal catheter made of German silver.

The operator must employ every precaution to protect the urethra and bladder from infection.

*Technic.*—The patient first passes as much urine as possible. Then with the patient in the recumbent position, the glans penis is carefully cleansed, the instrument lubricated and introduced slowly. Great care must be exercised when the prostatic urethra is reached. Too great force exerted at this point will easily cause laceration of the tissues which causes hemorrhage and invites infection. If the obstruction cannot be overcome after trying various catheters, the operator should desist. The beginner should be warned against using small, stiff instruments for two reasons. First, they are more apt to cause injury, and second, because a large one usually passes more easily into the bladder.

If the catheter enters the bladder, the urine is allowed to flow out. *If the bladder is overdistended, it should never be entirely emptied*, as fatal hemorrhage into the bladder has been known to follow this procedure. The amount of urine withdrawn (after the patient has passed as much as he could voluntarily) constitutes the *residual urine*. This is saved for laboratory examination. Before withdrawing the catheter it is well to introduce an ounce of sterile olive oil or gomenol, or a small amount of argyrol into the bladder and allow it to remain.

During the passage of the catheter or metal instrument through the prostatic urethra, the length of this portion of the tract can usually be estimated and frequently its tortuosity can be appreciated.

*Rectal Examination.*—This is always of importance. The finger in the rectum will easily detect any marked enlargement of the lateral lobes. If malignant disease exists, it is usually most marked in the posterior lobe, and one feels varying degrees of induration and hardness here which leads one at least to suspect cancer. Often intravesical enlargements of the prostate are present which cannot be determined by the finger.

*The Use of the Cystoscope.*—No instrument which has been devised for estimating the size, conformation, and relations of a diseased prostate has proved more useful than the simple prismatic or correct-vision cystoscope in the hands of an experienced operator.

The cystoscope is quite accurate for determining the size and contour of an intravesically hypertrophied prostatic lobe. The thickness of an intravesical glandular hyperplasia may be measured, and the prostatic urethra may be explored.

For these uses it is necessary to have an instrument in which the reflecting prism is so constructed that objects, even though they may be almost touching the surface of the prism, may be distinctly seen. One must, however, always make proper allowance for the magnification and possible distortion. For special use in cases of prostatic hypertrophy the writer has devised a cystoscope the curve of which resembles that of an ordinary sound. There are no sharp angles and the instrument is easy of introduction into the bladder. In fact, it is often possible to pass this instrument into the bladder in cases of prostatic hypertrophy even when a catheter cannot be introduced. In the ordinary case, in order to complete our examination, we first have the patient pass his urine and then we immediately introduce the small bladder cystoscope, measure the residual urine, wash out the bladder through the cystoscope, reintroduce the telescope, and make a further examination of the bladder. The essential points in the technic of the examination are as follows:

*Technic.*—The anterior urethra is made insensitive by the use of a 4 per cent. novocain solution. If the patient is supersensitive, two grains of alypin are deposited in the posterior urethra. The bladder cystoscope is then introduced as previously described. The bladder is filled with 200 to 500 c.c. of sterile water, or a 2 per cent. boric acid solution, and a thorough examination is made.

*Conducting the Examination.*—The base of the bladder and the ureter openings are first examined. This is essential, because there is frequently some bleeding caused by the instrumentation and the base of the bladder becomes quickly obscured. The urinary efflux is studied, diverticula, calculi, tumors, scars, and other pathological conditions looked for, *especially noting the presence and degree of trabeculation*. This will give some idea of the effect of the obstruction on the bladder. Sometimes we find distortion of the ureter openings, but there is seldom

interference with the urinary efflux unless the disease has progressed to the stage of involvement of the ureter and kidney. Diverticula occur most frequently near the ureter openings and at the vertex of the bladder. If there is an insufficient quantity of fluid in the bladder, the base sinks down and it is difficult, and often impossible, to examine thoroughly the pouch which is formed below the prostatic bar or median enlargement of the prostate. This difficulty may be overcome by introducing more fluid, which will tend to elevate the base of the bladder so that the trigone will come more fully into view. It is in this pouch, which forms mainly posterior to the interureteric band, that phosphatic concretions, diverticula, and stones are found.

As a result of chronic obstruction the muscular structure of the bladder wall becomes greatly hypertrophied and thickened. In the earlier stages of prostatic obstruction only a few of these bundles are seen crossing the wall; but as the obstruction becomes more complete



FIG. 272.—Cystoscopic picture showing false diverticula in a trabeculated bladder—the result of disease.

they appear as innumerable, well developed, interlacing columns, resembling a lattice-work, with larger and smaller branches, much like the muscular structure seen on the inside of the ventricles of the heart (Fig. 272). The spaces between these bundles frequently show the openings of diverticula, which vary greatly in size and depth; sometimes stones are found within them. Such pockets, when infected, give rise to an intractable cystitis. The superior surface and sides of the bladder do not share equally with the posterior surface in this change.

In many cases of prostatic disease there is present in the bladder some evidence of inflammation. It varies from a simple hyperemia of the base to a severe general involvement of the viscus. In the chronic forms the mucous membrane is swollen and pale; with acute exacerbations portions of the bladder appear more acutely inflamed, especially the trigone, but, as a rule, the rest of the bladder remains unchanged.

This naturally depends upon the intensity of the cystitis. In the old chronic forms the bladder will be found covered with shreds of mucopus and phosphatic concretions which are difficult to detach. If a stone of large size is present, a satisfactory examination cannot always be made.

*Examination of the Prostate.*—It must be remembered that in using the ordinary prismatic cystoscope, without the correct-view lens, the picture seen is inverted and considerably magnified. The newer lenses give a correct view with a magnified picture.

As the instrument is drawn back toward the urethra, after a thorough examination of the bladder has been made, the prostate will come into view and that portion of the organ covered by bladder mucosa can be carefully studied. Only a small portion can be viewed at one time. The operator should first view the entire orifice by turning the cystoscope through a complete circle. This gives an idea of the prostatic mass; any abnormalities may be noted, to be studied later in detail. The size and position of the median enlargement and its relation to the trigone and the ureter openings should be studied.

The normal prostatic orifice appears circular except at its posterior margin, which is flattened or slightly raised.

In bilateral enlargement of the prostate the anterior and posterior views show sulci of varying depths. As the instrument is turned around, the lateral lobes are seen to come together and project into the bladder.

In marked median-lobe enlargement the position of the cystoscope as it enters the bladder may be so influenced that it will lie in a sulcus between the median lobe and a lateral lobe, and it is only by raising or depressing the shaft of the instrument that a correct idea of the true conditions can be obtained.

The picture presented by a cleft formed by two hypertrophied lobes depends upon the position of the cystoscope. If the cystoscope is pressed up into the sulcus, the lobes are separated and no cleft is seen. But as the beak is lowered, the lobes press together and the cleft can be seen.

In this way the prostatic orifice may be studied, and a fairly exact idea of the degree and character of the prostatic enlargement be obtained.

*Of what Value is the Cystoscope in the Diagnosis of Obstructive Prostatic Hypertrophy?*—By the use of the instrument all the necessary intra-urethral instrumentation can be carried out; the presence of strictures determined; the length of the urethra measured; the amount of resistance in the prostatic urethra accurately felt by the hand; the amount of residual urine measured, and, in the great majority of cases, the presence of new growth or other obstructing intravesical conditions be excluded. The presence or absence of a calculus is always important to know beforehand, and this can be diagnosed with the greatest accuracy by the cystoscope. Oftentimes the presence of a stone in the bladder will cause sufficient congestion of a prostate to create obstruc-

tion. Furthermore, the exact position of the obstructing mass, be it a prostatic bar or a single ball-valve median-lobe enlargement, or a lateral-lobe encroachment, or an anterior-lobe obstruction, may all be determined before operation is undertaken. This knowledge may have an important bearing upon the character of the operation.

Before withdrawing the cystoscope the lamp should be extinguished, and with the instrument still in the bladder and one finger in the rectum the thickness of the prostatic bar can be determined by drawing the beak of the instrument down and engaging the prostatic urethra between it and the examining finger.

*Dangers of Cystoscopy in Hypertrophy of the Prostate.*—Fenwick states very positively that no patient over forty-five, suffering from nocturnal incontinence, great thirst, and morning nausea, should be subjected to cystoscopy. Fortunately, this combination of symptoms is rare. In cases where there is an enormous enlargement of the gland, cystoscopy is not necessary, but is not dangerous. The chief danger arises from rough handling and forcing the instrument through the prostatic urethra when there is great resistance. The obstruction can usually be passed by depressing the ocular end of the instrument. One needs simply to use the same precautions employed in any urethral catheterism.

**X-ray Examination.**—This is seldom employed as a routine method of examination in the diagnosis of urinary obstruction. It is of value, however, in those cases where the diagnosis is doubtful, especially where we know or suspect that a stone is present in the bladder. Occasionally a calculus is hidden in a diverticulum, and the ordinary examination with the finger does not always discover it. Frequently there are small stones which form in the substance of the prostate, but it has been our experience that they do not always register on the x-ray plate.

The x-ray examination is especially valuable in the cases in which there is a recurrence of the dysuria following prostatectomy. The pictures are taken, first with the bladder empty and second with the bladder filled with an opaque solution. The presence of calculi, diverticula, and irregularities at the outlet of the bladder can sometimes be demonstrated.

*How Far are We Justified in Insisting on a Complete Diagnosis before Operation?*—This depends to a certain degree on the condition of the patient and the stage of the disease. When a man between the ages of fifty and sixty years comes to the physician suffering from some increasing disorder of the bladder, and is still in good physical condition, great care should be taken to make as complete a diagnosis as possible before operation is advised. Frequently a stone in the bladder is the cause of the symptoms. Sometimes a neglected stricture of the urethra is found and, in fact, there are a number of diseases other than an enlarged prostate any one of which might be the cause of his symptoms. We feel that many disasters and incomplete operations would be avoided if more care were taken to make an exact diagnosis. The same rule should apply to the older patients who are not in the advanced

stages of the disease. On the other hand, where the patient is weak and infirm, and where the patient has been subjected to proper methods of treatment to overcome his urinary stasis without success, we are justified in operating at once to relieve the retention of urine without waiting to make a complete and often exhausting examination.

**Differential Diagnosis.**—If attempting to determine the type of change presented in a given case of obstruction at the neck of the bladder, it is important to remember that the same degrees of obstruction may be caused either by the large glandular hyperplasia of the prostate or the less apparent fibrous deformities. The former is much more frequent in men past sixty, while the latter is more often encountered in men who are younger. With regard to the clinical symptoms there is considerable difference of opinion. Some observers believe that the bladder symptoms are more distressing when fibrous changes are present, especially those which are the sequellæ of inflammation, while on the other hand we do not see some cases of glandular hyperplasia until after infection has taken place and our clinical picture is obscured. In fact many patients of the latter type suffer from as marked dysuria as those of the former. Therefore we cannot depend on the symptoms alone, but each case, when doubt arises, must be judged on the evidence obtained from a confined urethral, rectal, and cystoscopic examination.

**Chronic Prostatitis.**—There is usually a previous history of acute prostatitis. The clinical symptoms are often very slight and are not characteristic. There is usually an uneven enlargement of the prostate appreciable by rectal examination. The prostatic secretion, expressed by massage of the gland, and examined, contains pus cells. When the disease is of long standing, and has invaded the interglandular structures, more lasting changes take place and chronic obstruction may become established.

As a rule the cystoscope is not of great value here. It may, however, serve to differentiate between a chronic prostatitis and a median-lobe enlargement of the prostate. Where the median lobe is enlarged, the obstruction at the vesical neck is found to be caused by a smooth, rounded swelling which overlaps but does not necessarily encroach upon the trigone. With chronic prostatitis, the posterior segment of the prostatic urethra appears hyperemic, swollen, and infiltrated, so that when the instrument is pressed against it, it does not yield as easily as does the median-lobe enlargement. The swelling and infiltration may cause a slight bar formation with a pouch behind it, and the trigone itself may also be infiltrated and thickened.

**Tuberculosis of the Prostate.**—If tuberculous disease of the prostate, without involvement of the bladder, is suspected, the passage of a cystoscope or other instrument for examination is usually contra-indicated. In the presence of severe bladder symptoms, it is justifiable to use the cystoscope. The prostate will be found to be irregularly enlarged and its surface hyperemic and granulated. The hyperemia and irregularity of the surface and the lack of extensive hypertrophy

will often give a clue to the true condition of the prostate. In the more advanced cases ulceration may be present, and if so, bleeding takes place very easily. Rectal examination in combination with visual examination of the organ and the almost invariable presence of tubercle bacilli will make the diagnosis easy.

**Carcinoma of the Prostate.**—The question of the diagnosis of this condition has been fully reviewed in a subsequent chapter. It may be well to emphasize the fact that it is sometimes very difficult and sometimes impossible to make a definite diagnosis of carcinoma of the prostate. The disease usually begins in the posterior lobe and extends toward the trigone of the bladder without, as a rule, involving the mucous membrane covering it. Rectal examination reveals the prostate with areas of dense induration, in places as hard as a stone. If the glandular elements have become involved, the entire lobe may feel like a calculus, but, as a rule, it is not very greatly enlarged. With a cystoscope we find that although there has been considerable residual urine still there is no considerable hypertrophy or overgrowth of the prostate extending into the bladder. Secondly, the trigone is lifted and is decidedly more prominent than normal, and does not shift its position with the filling or emptying of the bladder. We can see, at the same time, whether or not there is any involvement of the bladder mucous membrane.

**Conditions Simulating Prostatic Disease.**—1. *Retention of Urine Due to Spinal Disease.*—Diseases of the spinal cord affect the bladder by causing incomplete muscular control, resulting in partial or complete loss of its power of expelling the urine. The patient passes urine frequently day and night, but never empties the bladder completely. Cystoscopic examination shows no hypertrophy of the prostate or median-bar formation. Young states that when disease simulating prostatic obstruction comes on late in life, and both rectal and cystoscopic examination show no hypertrophy or median-bar formation, with a large residual urine, we should suspect spinal disease.

In addition to the ordinary means of detecting spinal-cord lesions, the laboratory tests of the blood and spinal fluid will help to establish a correct diagnosis.

2. *Vesical Tumors Simulating Prostatic Disease.*—To differentiate between a vesical tumor and prostatic enlargement is not, as a rule, difficult inasmuch as the clinical symptoms are usually quite distinct. Some neoplasms, however, arising from or near the prostate are impossible of differentiation. If, however, we make an examination of the prostate and find that the prostatic body itself is not enlarged, or only slightly enlarged, and that at one point there is a decided outgrowth of new tissue, a vesical tumor may be suspected. As a rule, however, the tumor arises independent of the prostate, and by careful examination we are able to see a lack of continuity between the prostate and the growth, with a distinct area of normal vesical mucosa intervening. The ordinary papillomatous and ulcerating types of carcinoma are not difficult to differentiate. But a carcinoma involving the base of the

bladder, or a carcinoma infiltrating the base without ulceration, are extremely difficult to recognize.

3. *Vesical Calculus Simulating Prostatic Disease.*—In patients over sixty-five years of age a calculus may form so gradually that it is not suspected, the symptoms at no time being very severe. The first evidence of its presence may be due to the congestion of the prostate caused by a stone pressing against it. The first symptoms are usually frequency of urination during the day. Many such cases have been operated upon and the prostate removed, leaving the stone in the bladder, with the recurrence of the symptoms and the necessity of another operation. Cystoscopic examination will, of course, clear up the diagnosis, and a suitable operation will relieve the patient of his prostatic and vesical symptoms. Vesical calculi are present in about 25 per cent. of all cases of prostatic hypertrophy. The stone may be found in the postprostatic pouch or it may occupy a diverticulum. If a stone is found occupying a fixed position on the base of the bladder, it is extremely important to make a rectal examination in order to ascertain whether or not a portion of the stone is hidden in a diverticulum.

**Treatment.**—In considering the treatment of obstructions due to enlargements of the prostate or their associated lesions—deformities of the prostate—one must realize that we are dealing with lesions which are almost without exception progressive. The seeming recessions are not due to actual tissue changes in the prostate, but are the result simply of a lessened congestion, or removal of some irritating substance, causing edema of the prostate and its surrounding structures. As age advances the hyperplasia increases and in this way differs from the ordinary diseases of the body which frequently are associated with atrophy of the tissue after a certain age. Therefore we cannot employ palliative measures in the hope of carrying the patient over a certain period of advancing enlargement, but must face the fact that eventually the case will come to operation if it is a true hypertrophy, or death will result when our operative means fail to relieve the retention of urine and the infections of the urinary tract.

**Hygienic Considerations.**—The same general rules of hygiene apply to these elderly patients as apply to any condition of ill health in a man of mature years. It is especially important that the diet at all times should be mild; fruit juices are distinctly beneficial. Chilling of the body, wetting the feet, violent exercise, and in fact anything which would tend to increase congestion of the pelvic organs, will cause an increase of the distressing symptoms. In the earlier stages the patient often is tempted to hold his urine longer than he should. This has very frequently been followed by acute retention and has led to the first introduction of a catheter. Out-of-door life, moderate exercise, a bland diet, regularity of the bowels, regularity of meals, abstinence from alcohol, regular hours of sleep, a constant protection of the abdomen and pelvis from sudden chilling—these are the most important details in the life of the patient with an enlarging prostate.

The treatment of the early stages of enlargements of the prostate resolve themselves almost entirely into treatment of urinary stasis. Later, infections of the bladder and kidney appear and need to be dealt with.

When the symptoms in the early stage are intensified by the incidence of congestion or inflammation of the prostate they may be dealt with by non-operative methods. This consists of relieving the congestion of the pelvic organs as much as possible, by administering enemata to empty the bowel, by repeated sitz baths, by hot rectal irrigations, by prostatic massage, and by the exhibition of such drugs as urotropin, benzoate of soda, santal oil and the various balsams.

**Treatment of Acute Retention of Urine.**—If possible, the introduction of a catheter by the urethra under these conditions is to be resorted to only after all other means of relieving the patient have failed. Water and fluids by mouth should be restricted, rest in bed should be insisted upon. The patient should try to empty his bladder while sitting in a tub of hot water, and should be given various narcotics to diminish the reflex spasm of his internal sphincter muscle. If all these measures fail, then a relatively stiff silk-webbing catheter of the bougie or Mercier coudé type, preferably 18 to 22 of the French scale in size, should be slowly and carefully introduced. It is our belief that less harm is done with a silk catheter than with a soft-rubber catheter, which easily bends upon itself when it reaches the posterior urethra and sometimes causes very considerable injury. With acute retention, if a catheter has entered the bladder, the urine is allowed to escape slowly and, if the bladder does not contain more than 20 ounces or thereabouts, it may be entirely emptied. If there is an enormous distention of the bladder, not more than 20 ounces should be withdrawn at one time and a catheter should be left in place, properly stoppered, and the urine allowed to flow out from the bladder at intervals of from fifteen to twenty minutes until it is emptied. Then a non-irritating solution should be injected into the bladder and left there. The patient should be placed on a restricted diet of milk, should be kept perfectly quiet, should have his pelvis carefully protected and heat applied, and it will usually be found that it is unnecessary to pass the catheter more than once in this manner. If repeated catheterism is necessary, the same precautions must be observed each time.

**Treatment of Cystitis with Urinary Stasis.**—If infection of the bladder has taken place, the bladder should be catheterized each day, carefully washed out and injected with sterilized oil or some silver salt. Two ounces of 0.5 per cent. solution of silver nitrate is probably the best solution to use in these cases. It should be allowed to remain in the bladder for from five to ten minutes and then withdrawn. This treatment should be continued until the cystitis is overcome.

It is not our province here to discuss the treatment of inflammatory conditions of the prostate, and the reader is referred to the chapter dealing with this subject.

*Catheter Treatment of Cases of Urinary Stasis Due to Prostatic Enlargement.*—Increasing experience has more than ever demonstrated that the safest method of treating urinary retention due to obstructive enlargement of the prostate is by suprapubic drainage. This conclusion, of course, applies only to the cases that have reached the stage of chronic retention of urine. The fact that a man has an hypertrophied prostate is no argument for its removal unless it is causing active symptoms. The dictum does not apply to the beginning stages of hypertrophied prostate where we are called upon to treat active congestions from irritations of an enlarging prostate. But when enlargement of the prostate is causing sufficiently grave symptoms to demand some artificial means of emptying the bladder, the better procedure is through an opening above the pubis.

The statistics compiled by various urologists have demonstrated again and again that sooner or later within a relatively short period of time death from sepsis results from the initiation of catheter treatment.

In a work of this kind it is not our purpose to repeat the instructions for the choice of catheter, the methods of its sterilization and its means of introduction which have been so carefully worked out and written down by many previous writers. The same catheters and instruments are indicated in those cases where catheter treatment is insisted upon as are used for the purpose of diagnosis in cases of advanced prostatic disease.

We believe that there are very few cases, indeed, where one is justified in advising catheter life. In those exceptional cases where the condition of the patient will not permit of operation, the physician should himself select a catheter and instruct the patient in its use. He should advise the patient to empty his bladder by means of a catheter regularly night and morning and should tell him that more frequent catheterism is undertaken at the patient's own risk. It is manifestly more dangerous for any patient to have the catheter passed through his urethra four or five times a day than it is to have a suprapubic cystostomy performed under local anesthesia.

**Intra-urethral Methods of Treatment.**—As a palliative measure in enlargements of the prostate due to congestion and inflammatory processes, the catheter is frequently employed. Its uses in the early stages of a true hypertrophy of the prostate have already been referred to.

There are, however, a set of cases in which intra-urethral methods of treatment should be the methods of choice. These methods range from minor surgical procedures carried out through an endoscope, including the application of the high-frequency spark, to the more radical punch operation of Young and the more dangerous galvano-cautery operation of Bottini and the modification of this method advised by Chetwood. The cases in which these methods of treatment are called for are those which fall into the class already described under Urinary Obstruction without Hypertrophy of the Prostate, *i. e.*, submucous fibrosis, deformed orifice due to inflammation, and hyperplasia of the suburethral and subtrigonal group of glands.

The contra-indications to the more radical operation of prostatectomy are practically the same as those governing any major surgical operation in a patient of the same age.

We divide then our recommendations for treatment into four classes:

1. *Palliative treatment* in the prostatic enlargements due to congestive or inflammatory causes, also in the cases in which surgical operation is contra-indicated.

2. *Intra-urethral surgical treatment* in the cases of urinary obstruction without hypertrophy of the prostate.

3. *Suprapubic cystostomy*, as a preliminary step to prostatectomy, and as a permanent means of relieving retention of urine in cases in which prostatectomy is contra-indicated.

4. *Prostatectomy*, either perineal or suprapubic transvesical, in all cases of true hypertrophy of the prostate.

**Palliative Treatment.**—Why is this not justifiable in the cases of true prostatic hypertrophy? It may be tried as a temporary expedient, and then only in the early stages of the disease; but in the light of our present experience always under protest rather than as a measure possessing the full recommendation of the surgeon.

Doubtless in many cases operation on the first appearance of serious obstructive symptoms will be impracticable, either through the disinclination of the patient to submit to such an operation as prostatectomy, or his inability to give up from his occupation the time required for its performance and recovery thereupon. The catheter may be employed, provided its use is found to be unattended with any special trouble or discomfort.

**Intermittent Catheterism.**—As a temporary expedient to relieve an obstruction which may be expected to shortly disappear, intermittent catheterism is simple and efficient. It has its dangers, which consist, first, of possibilities of septic infection, which, while they may be reduced to a minimum by extreme care, are nevertheless always present, and in the peculiar conditions which surround patients suffering from urethral obstruction the necessary precautions are usually sooner or later imperfectly observed, and the introduction of sepsis takes place. It is a matter of occasional observation, however, that certain individuals exhibit a marked immunity to the results of such infection, indeed in some cases the use of an unclean catheter is persisted in for years with the production of only a very moderate amount of septic infection in the bladder. These cases, however, are so rare as to make more emphatic the statement that the continued use of a catheter is sure to result in a train of septic consequences of the most serious character. The majority of patients who elect to depend upon the continued use of the catheter for urinary relief enter upon a course which in itself progresses steadily to fatal termination within a brief period.

The second danger attending the use of a catheter is the immediate constitutional reaction which in occasional instances has been observed to follow its use, a reaction so profound in some cases as to terminate in death within a very few hours.

The third danger is referable to the local irritation, or traumatism, with which its introduction is attended. As the result of this there is pain and constitutional disturbance, though of a lesser degree than has already been mentioned, which follows each attempt at the introduction of the catheter. In those conditions of obstruction due to prostatic enlargement in which the question of catheter relief comes up for consideration, the character of the obstruction is such as frequently to insure and accentuate the pains and difficulties just indicated. These difficulties may often be very greatly lessened or modified by the choice of the best model of an instrument or by skill in its introduction, but in many cases even with the highest degree of skill and the best of instruments the local irritation incident to persistent attempts at the use of a catheter becomes so great as to be a serious element in the dangers of the case.

*The Catheter à demeure.*—As a substitute for intermittent catheterism the permanent tying in place in the bladder of a catheter is to be considered. Its value has received the commendation of men of the highest authority. Practically, however, it is found that marked differences exist in individuals as to their ability to tolerate the presence in the urethra of the instrument. When it can be tolerated, its use is free from the special difficulties and miseries incident to the continued frequent introduction of an instrument, especially in those cases in which the introduction of an instrument is difficult. In the best of cases, however, there is a certain amount of irritation of the urethral mucosa which attends its presence in the urethra; a moderate urethritis is produced. The irritation of the deep urethra is of special consequence in this connection, if, as seems to be well substantiated, there is any special nervous relation between this portion of the urethra and the secretory apparatus of the kidneys. One of the alarming results which attend the second group of dangers connected with the use of the catheter, already alluded to, is anuria directly dependent upon the irritation of the deep urethra, caused by the use of a catheter. This reflex effect upon the renal secretory apparatus must be kept in mind in determining the propriety of introducing or maintaining a permanent urethral catheter. This must be of special importance in those cases in which reflex renal disturbances dependent upon urethral and bladder conditions have already been demonstrated. It is in this last group of cases more particularly that, as a substitute for a permanent urethral catheter, the opening of the bladder above the pubis and the securing within the opening of a suitable drain to relieve the urethra entirely suggests itself.

**Suprapubic Cystostomy.**—Suprapubic cystostomy is a surgical procedure that has its own perils and requires the most careful attention to details of technic to reduce its dangers to a minimum. It commends itself especially in those cases in which a temporary relief to urinary prostatic obstruction is desired while the best general and local conditions are being secured for the later radical removal of the obstruc-

tion itself. It is free from any of the reflex effects which attend the introduction or retaining of a catheter in the urethra. It has still further the advantage not only of easy and adequate urinary drainage, but also of placing at rest the urethral tract and of being the most powerful agent in overcoming any reflex influence which the irritation of that tract may previously have been producing.

It is impossible to emphasize too strongly the great dangers of catheter life, and the lessening of the chances of complete recovery which delay and the inevitable infections of the bladder and kidney entail. Moullin<sup>8</sup> in his work on the prostate states, "I have more than once known suppression of urine to be caused by the introduction of a catheter into the urethra." And later, "Tying in a catheter must be regarded as a measure that should only be adopted when nothing else can be done." Likewise Wallace<sup>15</sup> in his book says: "The fact must be faced, that a patient practising self-catheterization is almost sure to fall a victim to septic infection of the urinary tract."

Figures sometimes emphasize a fact better than argument. From a series of thirty cases not subjected to operation and observed by Squier<sup>11</sup> the following conclusions were drawn:

Fifty per cent. of unoperated cases will die within five years from the onset of obstructive symptoms, where catheter life is not employed. The beginning of catheter life shortens this expectation of life almost 50 per cent. (two years and ten months) and increases the mortality 66.67 per cent. within the shortened period. *Fourteen of the seventeen patients who took up catheter life died* with an average duration of life of two years and ten months.

On the other hand, the immediate mortality following prostatectomy when properly performed is about 5 per cent. and the expectation of complete relief is over 80 per cent.

**Surgical Indications.**—The satisfactory establishment of surgical efforts for the radical removal of urinary obstruction, caused by enlargements of the prostate gland, must be accepted as now thoroughly accomplished.

It is of interest to note, in surveying the literature of the subject, that among the many different methods of attacking the prostate that have been proposed by different surgeons, practically equally good results are reported to have been secured by the most diverse methods by men who have become specially skilled in their application. It cannot be, however, that the choice of a method is a matter of indifference, a question of chance or prejudice. In view of the frequency of the malady, the general recognition of the possibilities of operative relief will prompt the surgeon to supply it. So the question is no longer what is possible in the hands of the expert, but what, in the light of our present knowledge of the anatomical relations and the pathological changes of the prostate gland, will in the hands of the average surgeon most certainly and safely, wholly and permanently, relieve the obstructive dysuria that the prostatic disease had produced.

The question of mortality naturally takes precedence in the con-

sideration of any operative proposition. There must of necessity be some mortality in any and every kind of surgical intervention in prostatic patients. Sepsis, renal insufficiency, and the multiple degenerations incident to old age are complications in varying degrees of combination, that have to be reckoned with in many instances, and which must determine a fatal exit inevitably in a certain proportion. The proper selection of cases and the due preparation of them for the hazards of operation will always engage the earnest attention of the surgeon, and by these means the mortality will be kept at a minimum. With the demonstration of the comparative safety and certain benefits of operation will come a resort to it much earlier in the course of the disease than has hitherto been the case, and with this will come a marked diminution in its hazards and a corresponding lowering of its death-rate.

The greatest advance made in prostatic surgery in the last decade has been the appreciation of the value of treatment preliminary to removal of the prostate. This has not only lowered the mortality rate in the total number of cases operated upon, but in addition has made it possible to offer operative relief to a class of patients who previously were denied operation.

In a word the chief object of preliminary treatment is the relief of the urinary stasis through drainage of bladder.

The primary effect of the drainage is decompression of the kidney; continuance of the drainage means a readjustment of the renal function.

Before discussing the relative value of the various methods of accomplishing this decompression it will be well to review the evidence at hand showing the cycle of renal functional adjustment in urinary obstruction.

*Clinical Evidence.*—The clinician will observe, in cases of prostatic disease in which there is considerable retention of urine, that there will be evidences of intestinal stasis, loss of appetite, loss of sleep, changes in temperament, mental degeneration, loss of weight and a general deterioration of the entire organism. Aside from this, further examination may show various phases of uremic poisoning; in many cases a very marked increase in the secretion of urine with low specific gravity. Frequently the amount of urine will reach 150 ounces in twenty-four hours and its specific gravity be as low as 1.002. In one case the twenty-four-hour record was over 300 ounces. This, of course is an indication of functional derangement of the kidney. The rapid disappearance of all these clinical evidences of disturbed renal function, which frequently follows drainage of the bladder, shows the direct relation of cause and effect.

We have both acute and chronic, partial and complete forms of obstruction.

In the cases of chronic partial obstruction it has been noted in general that the amount of urine secreted is increased, providing the bladder is strong enough to regularly overcome the partial obstruction, and partially empty the bladder so that at no time the back pressure from

the viscus is continually great. Where the musculature of the bladder is not so strong, and there is a chronic retention of a considerable amount of urine with very little overflow, the quantity secreted will often average as high as 120 to 150 ounces in twenty-four hours with a low specific gravity.

Where we have a contracted bladder with greatly thickened walls, in which there is only a small amount of urine retained, and its quantity almost entirely fills the contracted bladder, the urine is passed very frequently and in small amounts. Such a bladder may contain only two or three ounces and is almost continuously full. Under such conditions the kidney diminishes its secretion. The total amount secreted in twenty-four hours may be very little, finally resulting in complete anuria.

The other cases are those of acute retention of urine, in which the kidneys act freely until the bladder is filled to its capacity, at which time they stop acting entirely.

Aside from the clinical evidence of renal infection and renal insufficiency already presented, the most striking evidence of renal injury due to prostatic obstruction is presented in those patients dying from the disease. Autopsy shows a variety of conditions existing in the kidney, the most common lesion being a distended ureter beginning immediately above the bladder, resulting in various degrees of hydronephrosis and destruction of the kidney parenchyma. This in turn is influenced by the degree and duration of the obstruction and in many of the advanced cases is accompanied by infection, the formation of renal calculi, and, in some, by almost total destruction of the kidney parenchyma.

*Operative Proof.*—From a careful study of a series of cases in which a preliminary cystostomy was done, certain phenomena were repeatedly observed which seemed to justify us in dividing the results of advanced prostatic obstruction into three forms. It has further emphasized in our minds the peculiar balance existing between the heart, kidney, secretion of urine, and the nervous control of these in the patient who has gradually become used to overdistention of the bladder.

We have learned not to rely upon any one clinical sign or symptom in judging the fitness of the patient for operation. We have learned that the balance between the various elements of the system is so adjusted that a disturbance of one of them will bring to light weakness in some of the others which has not been suspected, for example, as may appear in the phthalein excretion by the kidney. This may be very deceptive. The patient may show 50 to 60 per cent. of excretion of phthalein in two hours before anything has been done to relieve the retention of urine. Drain the residual urine from the bladder and all of the other elements of the system are thrown into confusion. The back pressure is relieved; decompression of the kidney follows; swelling and congestion of the organ take place; and its functional capacity immediately drops to a very low point. The outward signs of this derangement are very evident. This is the second phase. It is our belief that in the case of

many of the patients who have died following operation, death has resulted from a lack of appreciation of this second phase of renal disturbance. Many deaths have been reported on the third to the fifth day following a one-step prostatectomy, when the patient was seemingly doing well; but when we take into account the phenomena of the second phase in addition to the shock of the major operation with its loss of blood and the depressing effect of the general anes-

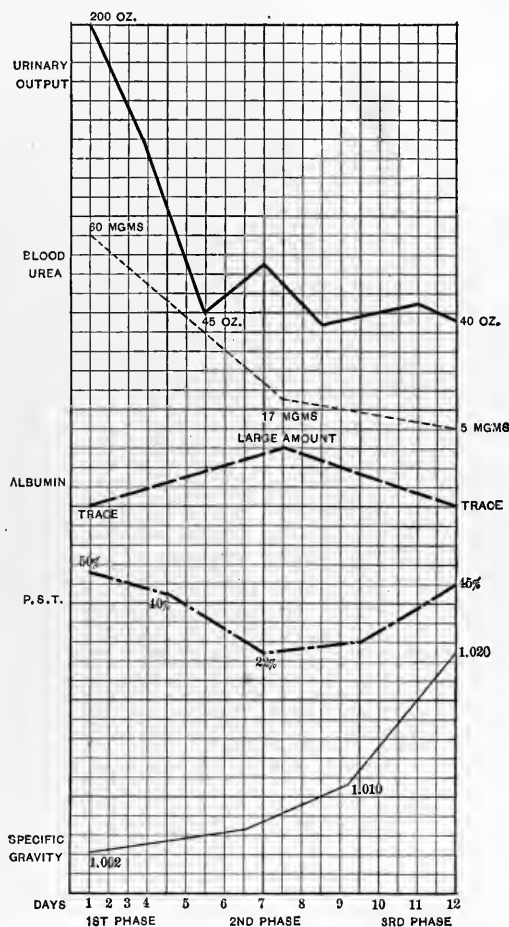


FIG. 273.—Chart showing changes taking place in the urine following operation.

thetic, it can be easily appreciated why these deaths take place, and many will agree that the overtaxed heart and the system overloaded with toxins which the kidneys should, but cannot, separate from the blood are the cause of the death. Extended observations have shown that nearly every prostatic will present these three phases, and this fact has influenced us very greatly in favor of the two-stage operation in every case of benign hypertrophy.

**The Three Phases.**—The results of our observations are graphically shown on the accompanying chart (Fig. 273) which shows the average condition which prevails in many advanced cases of obstructive hypertrophy of the prostate.

*The First Phase.*—For the first day, the day on which the suprapubic cystostomy is done, the blood-pressure frequently registers from 200 to 220 mm. of mercury; the urinary output for twenty-four hours will average from 70 to 120 ounces; the phenol-sulphone-phthalein test will frequently average above 50 per cent. in two hours and the urine will show only a trace of albumin. If these conditions are considered by themselves, they will give us a false impression of the actual condition of the patient. For example, if the patient's blood-pressure registered 200 mm. and he was passing 90 ounces of urine in twenty-four hours with low specific gravity and with only a trace of albumin, we would be rather suspicious of the functional capacity of the kidneys. But when we make a phenolsulphonephthalein test, and find that the output in two hours is 60 per cent. or more, it might lead us to believe that the actual functional capacity of the kidneys is greater than the specific gravity would indicate.

*The Second Phase.*—A second glance at the chart will show a very different condition existing on the third or fourth day after the bladder has been opened and drained. Here we see a lowered blood-pressure, probably between 170 and 180. The urinary output has suddenly dropped 15 to 20 ounces; the amount of albumin in the urine has increased enormously. On the third or fourth day the phenolsulphone-phthalein test shows the functional capacity of the kidney at this most critical time to be only 15 per cent. This, then, is the change that has taken place simply following a drainage of the bladder without any loss of blood or other surgical shock due to anesthesia or prolonged manipulation. If to the shock of a prostatectomy with its general anesthesia a very considerable loss of blood and the shock consequent to pain had been added, one does not wonder that so many patients have died on the third, fourth and fifth day from no apparent cause.

*The Third Phase.*—Passing to the third phase of the condition following drainage of the bladder, we find in the average case that on the seventh to tenth day the blood-pressure has decreased to 160 to 170 mm., the urinary output has increased to 40 to 50 ounces in twenty-four hours, the phthalein test shows a reaction of the kidney from a 15 per cent. output to one of 50 per cent., and the amount of albumin has decreased very markedly, it being still a little more than before the cystostomy and very much less than was found on the third or fourth day.

If the prostatectomy is performed now, the effect upon all these phenomena is quite different from that after a preliminary cystostomy. In the latter case the blood-pressure falls still lower, the urinary output decreases very little; the functional capacity of the kidney does not fall more than ten points; it is difficult to ascertain the amount of albumin present in the urine on account of the presence of the wound in

the bladder, but at no time is it as great as was found on the third or fourth day after the cystostomy was performed.

By following this method we entirely avoid the second phase after the prostatectomy.

Hugh Cabot<sup>2</sup> in studying the mechanism of the protection afforded by the drainage of prostatics as a preliminary to operation has observed certain phenomena which lead him to conclude that "the relief appears to be the result of two factors: (1) Relief of the so-called "back pressure" with the equalization of the kidney circulation thus resulting, and (2) lessening of infection which though long believed to be chiefly a cystitis, is now generally regarded as in fact a pyelonephritis." He states further: "No discussion is necessary to establish the now generally accepted view that the custom of preliminary drainage before operations for prostatic obstruction has been an important factor in reducing the mortality. Much obscurity, however, surrounds the reasons for the benefit thus produced and it is with this subject that we are here concerned. The importance of preliminary drainage is by no means equal in the various classes of cases presenting themselves for operation. It will probably be generally admitted that preliminary treatment, of which drainage is the most important constituent, is most essential in the class of patients who come to us with largely overdistended bladders, sometimes stretched to the point of overflow but in whom infection has not yet occurred. We all remember the dreadful mortality which accompanied the attempt to empty the bladder and remove the obstruction immediately upon coming under observation. It is notorious that these cases did badly from the start and died generally with the symptom-complex which we somewhat loosely call uremia. Perhaps the next most lethal proceeding was to operate at once upon those cases with a moderate residual of from 6 to 12 ounces and a still uninfected urine, while immediate operation was least hazardous in those cases with a moderate residual thoroughly infected and best typified by the patients who had for some time been leading the so-called catheter life. The extremes are represented by the overdistended uninfected bladder and the thoroughly infected but regularly emptied bladder enjoying a catheter life."

**Treatment Preliminary to Prostatectomy.**—It is quite evident then that a certain amount of preliminary treatment is indicated in every case before the final prostatectomy is attempted. The requirements in the given case must be judged by the individual surgeon. In the majority of cases one of three methods should be adopted. (1) The repeated use of a catheter to empty the bladder at regular intervals, or (2) The use of a catheter à demeure, or (3) The establishment of suprapubic drainage. The relative values of these methods and their indications have already been discussed under the heading of Palliative Treatment. While in most cases the surgeon may employ any of these methods with safety to the patient, still there are cases in which definite precautions are necessary. Although their variety is great, there are certain distinct types which represent those most commonly seen.

1. Patients who present themselves with enormously distended bladders, as yet uninfected, passing from 70 to 150 ounces of urine in twenty-four hours, with a low specific gravity and a trace of albumin, but with a relatively large percentage of blood urea. These cases call for a very gradual reduction in the amount of residual urine which can best be accomplished by the use of a catheter à demeure with gradual withdrawal of the urine, not emptying the bladder completely for two or three days; or, in the hands of the expert, the introduction of a button drainage tube through a cystostomy opening and gradually withdrawing the urine from the bladder in this way. If it is not possible to introduce a catheter, the patient should be kept as quiet as possible spending most of his time in bed, the bowels moved properly by salines and the amount of liquid given reduced to a minimum. At a favorable moment the suprapubic cystostomy should be done under local anesthesia and bladder drainage established.

2. Patients with very frequent urination or painful dribbling of urine due to partial retention complicated by a foul cystitis with or without the presence of a calculus. Where such a cystitis is present there is usually no contra-indication to the use of a catheter, but the greatest amount of relief will be afforded by a preliminary suprapubic cystostomy which provides for bladder drainage and then, depending upon the special training and aptitude of the operator, he will do a perineal or suprapubic prostatectomy. In all cases where suprapubic cystostomy has already been done, transvesical enucleation of the prostate can be accomplished more quickly and with less shock than is possible if a perineal operation is attempted.

3. Patients presenting themselves with complete retention of the urine, hemorrhage into the bladder, bladder distended, patient in shock. Unquestionably the safest procedure in such a case is an immediate performance of a suprapubic cystostomy under local anesthesia and simple drainage of the bladder.

4. Patients who have suffered for a long time from urinary stasis due to prostatic obstruction, who come to the surgeon as a last resort who are already suffering from uremic symptoms and suppression of urine. Some of these are beyond help, while others may be brought safely to operation and recovery. It is in this type of cases that we must expect some mortality. If we refused to operate upon them our 5 per cent. mortality record would be reduced to 1 or 2 per cent.; but even in this type many brilliant results are secured. Here preliminary treatment is absolutely essential and should be continued for two or three months before it is safe to enucleate the prostate. It is in these cases especially that the work of the surgeon should be supplemented by that of a physician to regulate the diet, to sustain the heart muscle and promote the well-being of the patient.

*How shall the surgeon be guided in selecting the time to perform the prostatectomy in a given case?*

First, his judgment should be based on the general condition of the patient. When the patient's appetite returns and his sleep becomes

normal, when his temperature, pulse and respiration become normal, and when the renal output has returned to its normal limits, he should consider these a fair index of the general physical well-being of the patient.

Second, prostatectomy is not safe until all the uremic and renal symptoms have disappeared. A moderate amount of albumin in the urine is no contra-indication. The condition of the blood-pressure is a valuable index.

Third, the phthalein test is of value only as taken in connection with other signs. In the first place one must consider the results of the phthalein test before the preliminary drainage; then the phthalein test taken on the second, third or fourth day, and again, the functional reaction of the kidney to this test at the end of a week or ten days. It is a mistake to rely solely upon this test, especially before the drainage has been instituted. For example, the test may show excretion of more than 50 per cent. of phthalein in the first two hours before the preliminary cystostomy, but the reaction may drop on the second or third day after relief of the retention of urine to below 15 per cent. or even lower, which is a true indication of the functional capacity. When, however, the period of depression is passed and the output returns to 50 per cent. after the retention of urine has been relieved, this then becomes a fair index of what we can expect the kidney to do after the prostate has been removed. Of far greater value, however, is a combined estimation of the phthalein output, the urea excretion, the specific gravity of the urine, and the actual amount of urine excreted in twenty-four hours, taken in connection with a determination of the blood urea and blood creatinin. The surgeon, however, must always take into consideration the general physical condition of the patient before counselling prostatectomy.

A persistently low phthalein output is not necessarily a contra-indication to operation, providing that these other clinical evidences of good renal function are present.

*Expectation of Cure.*—The primary indication is the reëstablishment of the ability of the individual to readily, fully and painlessly evacuate his bladder. With regard to the restoration of normal function it must not be forgotten that the statements both of patients and of surgeons should always be considered as relative. Prepossession and enthusiasm often lend a rose color to the reports of results, and a more close scrutiny of the conditions may often elicit information as to attendant infirmities which modify the conclusions. Nevertheless, even with these modifications, the fulfilment of the supreme indication, viz., the removal of the urinary obstruction, is a sufficient achievement to compensate for the presence of many lesser evils.

The patient who comes to us in the early stages of the disease before infection has taken place can be assured today that the result of removal of his prostate will be a full restoration of the bladder to its normal function, with full control of his urine and the ability to completely empty his bladder. When marked deformity of the outlet has taken

place as a result of fibrous changes, the end-result is usually not as satisfactory, but even in these cases, which are relatively few in number, marked improvement in the obstructive symptoms results.

The patients who present themselves in the advanced stages of the disease, often surprise the surgeon by the completeness of their return to the normal condition. The extensively trabeculated bladder, with its hidden recesses the seat of chronic inflammatory changes, can never be expected to return to its normal state again, but aside from the evidences of a low-grade chronic cystitis, the patient is freed from his frequent painful urination and his urinary stasis. Wherever it is possible to remove the obstruction completely the percentage of failure is almost *nil*. The so-called failures recorded are in the opinion of the writer due to incomplete operation.

The infirmities which sometimes mar the results are *impotence, urinary incontinence, epididymitis and orchitis, fistula, stricture of the urethra*.

*Impotence*.—This results from injury to or removal of the ejaculatory ducts. It is less likely to occur when the operation is done from above, but with proper care the segment carrying these ducts and terminating in the verumontanum can usually be preserved during a perineal enucleation. It is a surprising fact that the sexual vigor, if present before the operation, is very little impaired by removal of the hyperplastic portions of the gland.

*Urinary Incontinence*.—This is of rare occurrence as a result of prostatectomy. A slight defect in the ability to retain urine in the bladder may be present during the first weeks following operation, but the sphincters rapidly regain their tone and full control of the urine is established.

In our own series of cases we have never seen incontinence following a perineal or suprapubic prostatectomy. I believe this to be due to the fact that in every case the compressor urethræ muscle has been carefully preserved. It is our belief, further, that in the majority of cases in which incontinence of urine has followed an operation, it has been the result of an attempt to remove a prostatic obstruction where the hyperplastic masses were not easily enucleatable. In other words, it is only apt to occur in those cases where there is no distinct defining capsule and the overzeal of the operator makes him pass beyond the confines of the prostate, in doing which he injures or removes a portion of the muscle which controls urination. The injury or removal of the internal sphincter does not have any effect upon the actual muscular control of urination, as has been frequently proved practically where operations have involved the removal of the internal sphincter, and a full control of the urine has resulted.

*Epididymitis and orchitis* are seldom seen unless instrumentation of the urethra is employed after prostatectomy. Rarely does epididymitis follow the operation alone. In our own series of cases epididymitis occurred much more frequently in the perineal than in the suprapubic sections. In a few cases the inflammation extends and may involve the

loss of a testicle, and may cause extensive sloughing of the tissues resulting in an urethrorectal fistula.

*Fistulæ.*—Suprapubic fistulæ, perineal fistulæ and recto-urethral fistulæ are among the occasional sequelæ of operation for the removal of the prostate. They occur with sufficient frequency to make their mention necessary in any complete consideration of the subject of prostatectomy, but yet so rarely as to have very little practical bearing on the prognosis of a given case. In the absence of great loss of substance in the original wound, the failure of a suprapubic or perineal opening to close is usually due to some contraction in the anterior urethra, and, as a part of the treatment in any given case, the surgeon should secure perfect freedom of the urethral lumen throughout its whole extent.

Recto-urethral fistulæ may result either from an accidental tear through the anterior wall of the rectum in the course of the efforts to expose the prostate or from later sloughing consequent upon intense local infection, or from drainage tube, or tampon pressure. The very close relation of the prostate and the rectum at once suggests the difficulty of separating them without injury to the rectum, and the possibility of such injury doubtless had much to do in discouraging earlier attempts on any general scale to attack the prostate. Fortunately, however, between the capsule of the prostate and the underlying musculofibrous external coat of the rectum there is an appreciable layer of loose connective tissue which forms a line of easy cleavage, so that when the capsule of the prostate has been exposed, the further stripping back of the rectum to any degree that may be necessary is comparatively free from danger of injury to the bowel. It is that portion of the rectum which is anterior to the prostate, and which is pulled forward toward the membranous urethra by the recto-urethralis muscular fibers, which is most likely to be the seat of injury when the prostate is approached from the perineum. With care and due attention to the anatomical relations of the structures involved, this point of danger may usually be avoided; but it is quite conceivable that in occasional instances the relations and texture of the perineal structures may be so altered by fibrous or inflammatory changes as to make the desired detachment and pushing back of the rectum without injury very difficult to accomplish. That such injury has occurred at the hands of many able surgeons is a matter of record, and it is not unreasonable to believe that not all the instances in which it has occurred have been published.

In our earlier experience such injury to the rectum occurred twice as the result of misadventure in the course of the effort to expose the prostate, both times in cases of small fibrous prostates with increased rigidity of the recto-urethral muscular mass. In a third case an opening into the rectum occurred fourteen days after operation, as the result of a slough due to wound infection. In two of these cases the fistula was subsequently completely repaired by plastic operation; in the third case, a plastic failed to close the fistula and, other circumstances

having prevented its repetition, the fistula persisted during the remaining two and a half years during which the patient's life was prolonged, about two-thirds of the urine passing into the rectum at each urination, requiring the man to sit upon the stool to void it.

*Urethral stricture* does not seem to have followed to any serious degree the extensive lacerations and removals of the prostatic urethra which have marked many of the operations upon the prostate. It has been frequently the case that the entire prostatic urethra has been taken away with no subsequent disturbance of the urinary functions. Extensive tearing away of the prostatic urethra has accompanied certainly some, and probably all, of the extensive enucleations done by the suprapubic route; a varying degree of injury to the floor and lateral walls of the prostatic urethra attends most of the perineal methods of operation. The claims of many operators who remove prostatic masses guided by the sense of touch alone, that very limited injury of the urethra results from their manipulations, are not sustained by our knowledge of the anatomical conditions of the parts. The urethra in its course through the prostate does not present such distinct layers in its walls as are found in its membranous and penile portions; nor does it present any such recognizable layers as does the capsule of the gland from which the adenomatous masses of an enlarged organ can be readily peeled away. It consists of a few layers of columnar epithelium resting on a base composed of connective tissue and muscular fibers which are directly continuous with the stroma of the gland itself, and surround and support the score and more of ducts to which the primary lobule outlets converge, and which open upon the floor of the urethra, and which are also lined by an extension of the urethral epithelium. In other words, the submucous and muscular coats belonging to the urethra in other parts of its course are here replaced by prostatic substance. It seems to the writer that the laceration of the urethral wall by attempts to tear out more or less of the glandular substance external to it can be prevented only by the most delicate manipulation, conducted in full view and with the assistance of careful dissection as the enucleation approaches the vicinity of the urethral wall. The periphery of these prostatic masses can readily be enucleated from the capsule with a blunt dissector or with the finger-tip; but upon the urethral side of the mass the condition is different. These masses can be readily torn away, it is true; but the operator who thinks that in effecting this he leaves the prostatic urethra intact is probably mistaken. More emphatically is this the case in the presence of the hard, fibrous prostate.

It may be well therefore to accept as one of the usual accompaniments of prostatectomy, a very considerable laceration and loss of substance of the prostatic urethra. In view of this the fact of its regeneration has decided surgical interest. When the roof and a considerable portion of its lateral wall is left after the enucleation is completed, it is natural to expect that the conditions insure a patent mucous-lined canal as wound healing progresses; in those other cases in

which nearly complete enucleation of the whole gland *en masse*, bringing with it a considerable segment of the whole circumference of the urethra, is effected by attack from within the bladder, there remains an irregular, but in general a funnel-shaped, cavity, into which the bladder mucosa must prolapse, and as the process of repair progresses, furnishes an advancing line of epithelium to cover the raw surface. From the end of the membranous urethra likewise a similar epithelial growth may contribute to the ultimate result; from the ducts and lumina of any of the gland substance that may have escaped the surgical attack an additional source of epithelium may be supplied. This may explain why speedy regeneration of an adequate epithelium-lined canal through the area formerly occupied by the prostate has been demonstrated by abundant clinical experience. The very natural apprehension entertained by many that intractable stricture would be a common sequel to these operations has not been realized. In order to secure this immunity from later stricture, it would seem that the urethral injury must be restricted to the prostatic portion of the urethra. It would seem also a sound surgical procedure in all cases to place a good-sized rubber drainage tube in the bladder through the prostatic hiatus during the early days after the operation, to be replaced later, possibly for a week or more, by a catheter à demeure; this, in addition to the advantages of drainage, answers the purpose of favoring and controlling the formation of a suitable channel, along which the process of epithelial proliferation should extend. The occasional use of a full-sized sound may be adopted as a substitute for the catheter for a time in the subsequent treatment.

**The Surgical Problem.**—To state the case in its simplest terms the problem presented in obstructive lesions of the prostate is:

1. To provide a free exit for the urine from the bladder.
2. To permanently remove the obstruction at the neck of the bladder.
3. To preserve the sphincter vesicæ, and if possible, the ejaculatory ducts.
4. To prevent postoperative shock and hemorrhage.
5. To prevent infection and sloughing.
6. To secure rapid healing of wound and the reëstablishment of the normal functions.

**The Choice of Operation.**—Intra-urethral methods of operation are indicated in the cases of obstruction due to submucous fibrosis; bar formations of inflammatory origin, and obstructions due to hyperplasia of the suburethral and subtrigonal glands. In the remaining cases there are but two methods of operation to be considered, namely, perineal and suprapubic-transvesical prostatectomy. So much has already been written concerning the relative merits of each that a full discussion of the subject is not necessary. It is safe to say that the majority of surgeons have adopted the suprapubic transvesical method. In the hands of a few specially trained men there is practically no choice between the two methods, judging from the mortality records, and the character of the end-results. But this does not hold good when we

consider the results of the operation in the hands of the general surgeon to whom the major portion of the work comes.

Perineal prostatectomy is an operation for the expert only. Suprapubic prostatectomy is an operation *per se* which can be easily performed by the majority of surgeons. In the latter operation the chances of accident are less and the certainty of completely removing the obstruction is greater than when perineal prostatectomy is attempted by a surgeon who is not specially trained in the surgery of this region. Many men encouraged by the brilliant results of a few who popularized the perineal operation, attempted the operation and brought discredit to it by their failures. The same is true to a lesser degree of the suprapubic operation. The fact is that success in removing prostatic obstructions depends upon a fundamental knowledge of the pathology of the disease, not only as it affects the prostate itself, but more especially as it affects the bladder and ureters and kidneys. The mortality percentage in a given series of cases does not depend upon the particular type of operation employed, but it does depend upon the individual surgeon who performs the operation, his pre-operative study of the case, his ability to anticipate the dangers before they arise, and his skill in meeting the emergencies as they occur.

Some expert urologists who operate upon the majority of their cases by the suprapubic route still employ the perineal route in those cases where the obstruction is caused by a small fibrous prostate. Practically all surgeons agree that the suprapubic operation is preferable in those cases in which there is a massive intravesical overgrowth of the gland. Many surgeons perform suprapubic prostatectomy in two stages, the first operation consisting of a cystostomy with drainage of the bladder; the second operation, enucleation of the prostate through the existing cystostomy opening. This is the method preferred by the writer. Other surgeons complete the operation in one stage. Experience and a proper consideration of the individual case should always guide the operator.

*Removal of Obstructing Growths per Urethram.\**—Attempts to remove the obstruction at the neck of the bladder by means of instruments introduced and operated through the urethra date back for over a century. The sum total of the experience gained during that period and especially during the past twenty years is, that no permanent relief can be gained excepting in the cases of the irregular forms of obstruction which we have described under the headings, Submucous Fibrosis, Bar Formations Due to Chronic Inflammatory Changes, and Obstructions Due to Hyperplasia of the Suburethral and Subtrigonal Glands.

In dealing with these types we have a choice of various methods: Destruction of the obstruction by means of the galvanocautery knife, or the high-frequency spark, or actual removal of the tissue by means of an instrument which punches out the tissue. Mercier, in 1839, devised the first instrument for actually excising portions of the growth,

\* For an extended history and description of this method see Deaver's "Enlargement of the Prostate." Blakiston's Son & Co., Philadelphia, 1905, p. 176.

improving his technic and adding a blade for simply cutting through a median obstruction. Bottini, in 1874, introduced his method of division and incision of the prostatic obstruction by means of a galvanocautery instrument, hoping by this method to avoid the hemorrhage which was so dangerous a complication of the Mercier method. These surgical procedures were extensively tried, modified, and improved, and were the methods of choice until the present technics of perineal and suprapubic prostatectomy were introduced; then it was demonstrated that the operation of complete removal of the diseased portion of the prostate was just as safe as these partial expedients, and the results were far more satisfactory and lasting. The result has been that most of these operations conducted per urethram have been discarded in the cases of true hypertrophy of the prostate. There still is a limited field, *i. e.*, in the irregular forms of obstruction, for the partial excision and electric-spark destruction.

H. H. Young,<sup>17</sup> in 1909, devised an instrument very much like the original Mercier tube, which he uses in these irregular forms of obstruction. The instrument consists of a long sheath with a curved beak suitable for introduction through the urethra into the bladder. On the surface opposite the concavity of the tube and proximal to the curve there is an opening, which is closed, during the introduction of the instrument, by an obturator (Fig. 274).



FIG. 274.—Young's urethroscopic median bar excisor. (Randall.)

*Technic of the Young Punch Operation.*—The patient is carefully prepared as for any major operation. He is then placed on the operating table in the lithotomy position, the urethra and bladder cocainized, and the bladder filled with water. The instrument is then introduced until the beak enters the bladder. The obturator is withdrawn and the posterior urethra is illuminated by reflected light. Then the instrument is advanced until the fenestrum slips over and engages the obstructing mass or bar (Fig. 275), which partly fills the lumen of the tube at this point. A second tube, with cutting edge, is then passed in and cuts out or punches out the tissue which protrudes into the lumen of the tube. The first punch is made posteriorly. Then, if necessary, other pieces of tissue are excised on the lateral aspects of the opening; until the operator is satisfied that he has made a sufficiently large opening to permit the free passage of the urine. The bladder is then thoroughly irrigated with hot solutions, and a large catheter is introduced and left in place, through which the bladder is repeatedly washed to prevent the accumulation of blood clots.

This method has been employed by Young in a large series of cases, and he reports universally good results in the cases of "median-bar formation," but condemns its use in the cases of true prostatic hypertrophy. It is not without its dangers, however, and should be employed with caution. Other operators report cases in which the hemorrhage attending and following it have necessitated opening the bladder to control the bleeding.

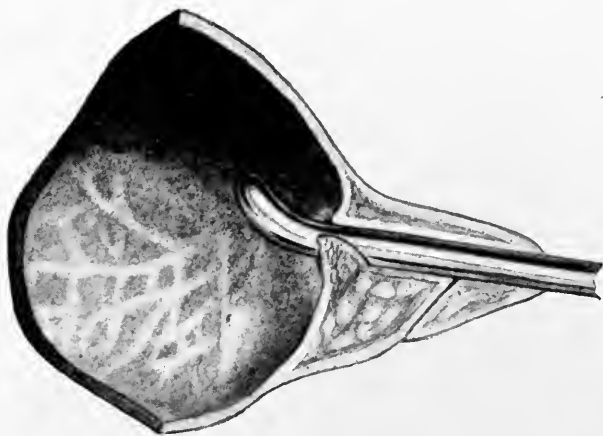


FIG. 275.—Young's instrument in operation. (Randall.)

**The High-frequency Spark Operation.**—This form of treatment is applicable in the same class of cases as the Young's punch operation. The spark operation is less trying for the patient, and eliminates almost entirely the danger of hemorrhage. The patient is prepared as for a cystoscopic examination. A catheterizing cystoscope of small size, or a cysto-urethroscope is used. With the instrument in place, the obstructing mass is brought into view and the electric wire is advanced until it engages the tissue. Then the spark is applied for a period of from twenty to thirty seconds, or until the tissue shows destructive effect of the spark, dependent, of course, on the strength of the current. The spark is applied along parallel lines, reaching well across the obstruction. It is best to be cautious with the first application, doing too little rather than too much. After a period of two weeks, the cystoscope is again introduced, the effect observed, and further treatment applied. Considerable improvement should follow after the fourth or fifth treatment.

Bugbee,<sup>1</sup> who has treated a number of cases by this method, has published the following conclusions:

The residual urine has been eliminated in all cases of median-bar obstructions, as well as those due to cicatrix and chronic inflammation of the vesical neck.

Partial relief was obtained in cases of incomplete prostatectomies with nodules of prostate remaining about the vesical neck.

Of the patients with glandular hyperplasia, nine in number, three have died of intercurrent disease; two are symptomatically relieved; three are still under treatment. In eight of the nine treated, the residual urine was lessened. In one case there was no improvement.

The cases of lateral-lobe enlargement have shown little improvement. These results bear out the belief of the writer that the high-frequency current should be reserved for the cases of submucous fibrosis and enlargements due to chronic inflammatory changes alone.

**Transvesical Prostatectomy.**—Transvesical prostatectomy has been employed for many years with varying degrees of success. Its universal acceptance as a method for enucleation of the prostate has been delayed by several unpleasant, and often dangerous, features which have resulted from imperfect technic. Chief among these factors have been:

1. The discomfort of the patient due to continuous urinary leakage from the suprapubic wound.
2. The sloughing and infection of the wound.
3. Incomplete control of hemorrhage.
4. Confinement in bed.
5. Prolonged urinary leakage.
6. Long-continued urinary fistulæ.

Since these objections have been overcome by the employment of a special technic, transvesical prostatectomy has become more popular than perineal prostatectomy. Since a suprapubic cystostomy is usually done as the first step of a transvesical prostatectomy, division of the operation into two stages has naturally suggested itself and is now employed by many surgeons in preference to preliminary catheterism and later transvesical prostatectomy. A discussion of the merits of these steps has already been given.

In those cases in which the operation of transvesical prostatectomy is completed in one stage the technic of the cystostomy is exactly the same as when a cystostomy is performed, with the exception of the closure of the wound. Therefore the two will be described together.

The writer prefers the two-stage operation in practically every case of glandular hyperplasia of the prostate for the following reasons:

1. It permits of renal decompression with the least risk.<sup>9</sup>
2. It provides complete urinary drainage without any urinary leakage. The result is a dry wound and allows the patient to be out of bed within twenty-four hours after the cystostomy.
3. Primary union of the suprapubic wound is secured around the opening into the bladder through which the prostate may be enucleated, thus excluding the tissues of the prevesical and perivesical spaces from the operative field and preventing infection and extravasation of urine.

With the drainage tube in place and the urine entirely controlled, an indefinite period may be allowed for the patient to recover from his stage of depression and a time may be chosen for the prostatectomy which is most favorable for the patient. Often without further incision for the use of any instrumentation the enucleation of the prostate may be

accomplished through the opening already provided, thereby greatly diminishing the possibilities of surgical shock and limiting the area in which infection may develop.

**Suprapubic Cystostomy.**—Cystostomy is employed either as a first stage of the two-step operation, or as a preliminary to transvesical prostatectomy. The operation is performed under local anesthesia.

*Preparation of the Patient.*—The usual catharsis is given forty-eight hours previous to the day of operation. No catharsis or enema is given within twenty-four hours of the operation. The field of opera-

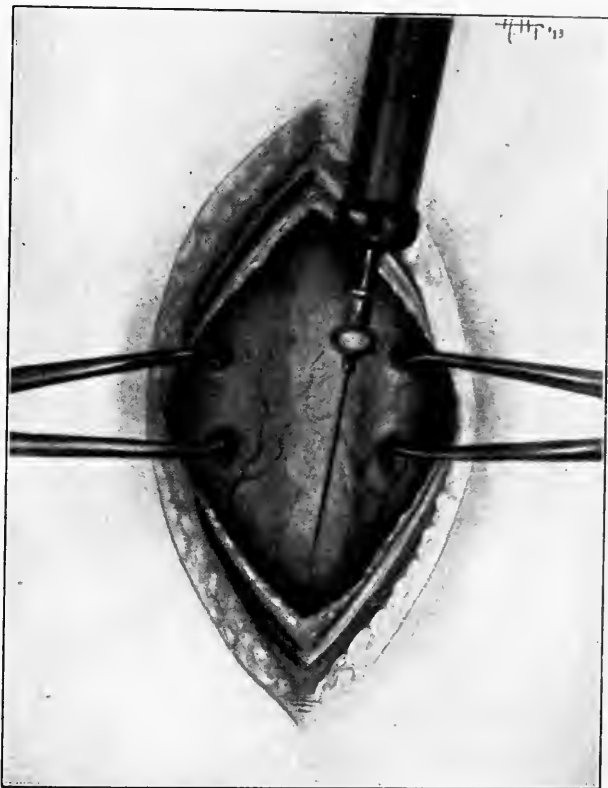


FIG. 276.—Infiltration of bladder with novocain. (Lower.)

tion is prepared by shaving the parts and cleansing them with soap and water the day before operation. Just before the operation is commenced iodine is applied to the skin.

In emergency cases the area is shaved, Harrington's solution is applied, followed by washing with alcohol.

Special efforts are made to inspire the confidence of the patient before the operation. Examinations are made with the utmost gentleness. The night before operation the patient is given 30 grains of sodium bromide and this is repeated on the morning of the operation. In many

cases morphin, grain  $\frac{1}{4}$ , combined with atropin, grain  $\frac{1}{150}$ , is given by hypodermic injection half an hour before the operation. Many urologists object to the use of morphin in these cases, but the writer feels that their objections are not sustained. Wherever possible the principles of anoci-association are employed during the performance of the operation.

This is advocated both during the cystotomy and later in enucleating the prostate. Lower's<sup>4</sup> technic is as follows:

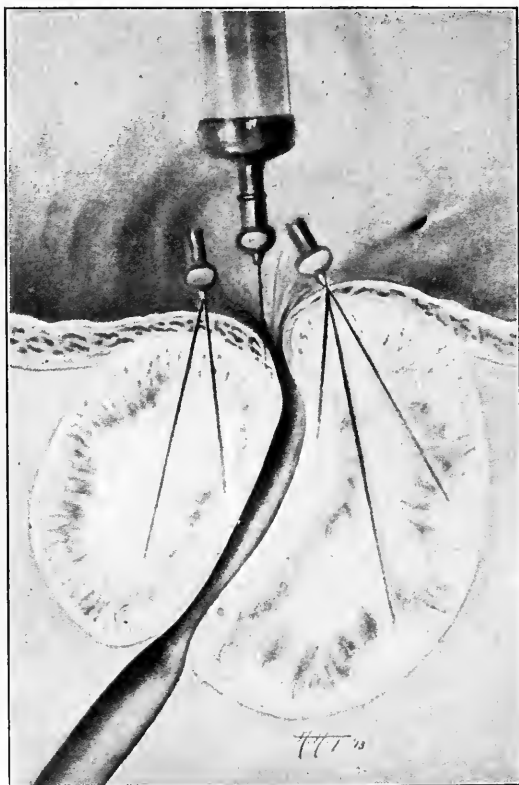


FIG. 277.—Deep infiltration along edges of capsule of prostate before removal. (Lower.)

1. An hour before the operation the patient is given a hypodermic injection of morphin and scopolamin, the size of the dose depending upon the age of the patient.

2. Immediately before the operation the bladder is irrigated and 60 to 90 c.c. of a 5 per cent. solution of alypin is injected through the catheter. The catheter is clamped and both catheter and solution are allowed to remain.

3. The bladder is approached in the usual way except that the skin incision and every division of tissue is preceded by a thorough infiltration with novocain in  $\frac{1}{400}$  solution.

4. When the bladder is exposed it is elevated with curved hooks and thoroughly infiltrated with novocain solution (Figs. 276 and 277).

*Technic of Suprapubic Cystostomy.*—The skin incision begins about one inch above the symphysis and is continued in a vertical direction toward the umbilicus for about four inches. The fat and fascia are divided with a knife and the recti muscles are separated by the finger; the remaining fascia and prevesical tissues are easily separated. At this point the bladder is well filled with sterile water through a catheter introduced by the urethra. If it is not possible to introduce a catheter without undue force, it is not attempted.

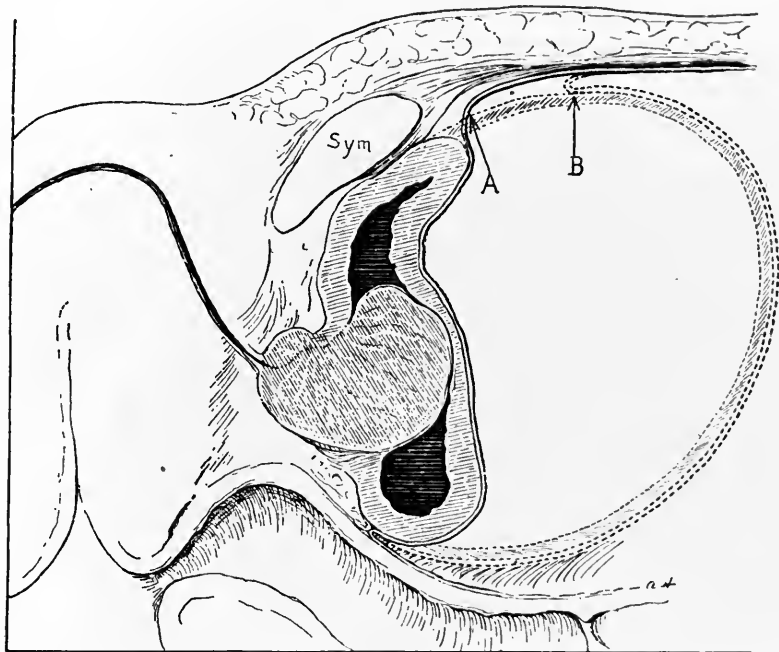


FIG. 278.—Showing the surgical problem. Special attention should be directed to A, the fold of peritoneum in its relation to the symphysis when the bladder is contracted. B, the raising up of the peritoneal fold when the bladder is dilated. The relation of A and B to the symphysis is quite variable and in some instances is fixed at the level of the symphysis.

With the bladder full the finger is introduced into the wound until the under surface of the symphysis pubis is reached; then the finger covered with gauze is slowly swept upward, gradually lifting the tissues away from the anterior surface of the bladder, at the same time forcing the peritoneal fold upward. This is of great importance because the peritoneal fold frequently descends low and lies over the anterior wall of the bladder where it is desired to expose it (Figs. 278 and 279). After the bladder wall has been cleared it will be recognized by the tortuous dilated veins presenting on its surface, extending upward in a fan shape.

Also the appearance of the thick muscle bundles of the bladder wall is characteristic. When the finger is removed the peritoneal fold will

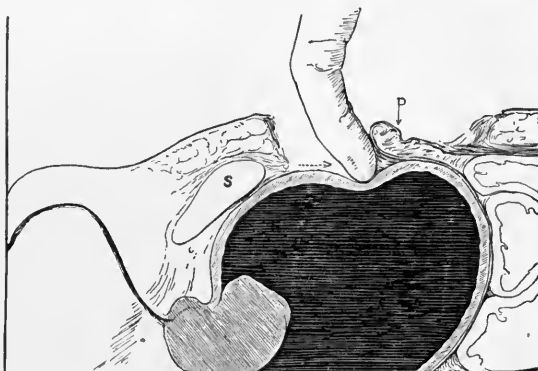


FIG. 279.—Second step, freeing anterior wall of the bladder, preparing it for incision. Finger has been swept upward from symphysis along anterior face of the bladder carrying with it peritoneal fold *P*. If finger is removed from the wound at this point, the peritoneal reflexion will be seen forcing its way downward with each respiration of the patient.

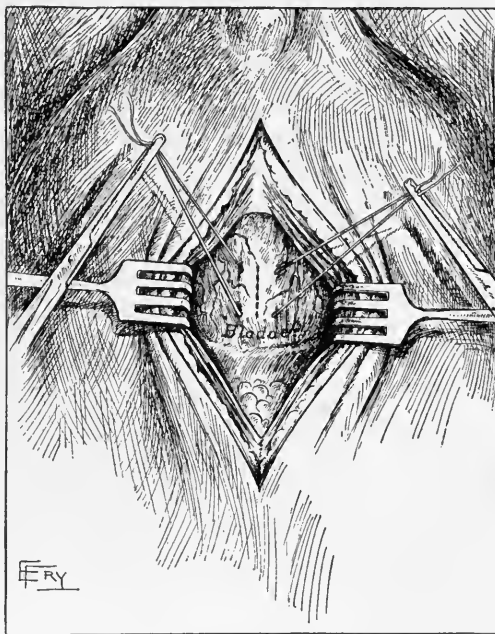


FIG. 280.—The bladder wall is seen exposed and the position of the incision is indicated near the fold of the peritoneum. The two stay sutures are in place and hold the bladder wall up. As soon as these sutures have been introduced the fluid is withdrawn from the bladder.

bulge downward. Great care must be exercised in pushing back the peritoneum, for it is easily torn. This accident has occurred to the

writer, but no untoward symptoms follow the injury if the wound is immediately closed.

When the bladder wall is properly bared, retractors are introduced, two lateral ones to hold back the muscles, and one in the upper angle of the wound to hold back the peritoneal fold. When all is in readiness, two retaining sutures are introduced into the bladder wall (Fig. 280), about an inch apart on either side of the point where the bladder is to be incised. This point is chosen at the uppermost limit of the bladder near the peritoneal fold. Before the bladder is opened the fluid is allowed to flow out through the urethral catheter. The button drainage tube (Figs. 281 and 282) is held ready for use. Then the bladder is held up and steadied by the stays, or clamps if preferred, and an opening is made at the point chosen. The finger is inserted through the opening, the interior of the bladder explored, foreign bodies, calculi, etc., are removed and the character and size of the prostate is



FIG. 281.—de Pezzer catheter.

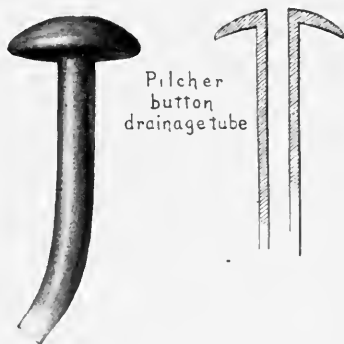


FIG. 282.—The Pilcher modification.

determined. When the finger is withdrawn the button drainage tube is immediately inserted and fixed in place either by a purse-string suture of chromic gut or silk or by tying the stay sutures around the tube (Fig. 283). If it is undesirable to empty the bladder the tube is plugged with a cork; otherwise it is allowed to drain as it will. At times small vessels in the bladder wall are injured. These should be clamped or ligated.

*The Drainage Opening.*—One should be perfectly satisfied with the position of the opening in the bladder before completing this step of the operation. If after exploration the opening is found to be in the lower half of the bladder, which would bring it too near the urethral outlet, it is better to reintroduce the finger in order to better outline the upper limits of the bladder (Fig. 284), and with this as a guide, slowly dissect back the peritoneum and make a new opening higher up (Fig. 285). Then the first opening should be closed with a

double layer of chromic gut (Fig. 286). In this way we can almost certainly assure ourselves of a rapid closure of the suprapubic wound, provided that all of the obstructing prostate is removed.

Being satisfied with the fixation of the tube and its position, and after testing it to see that it drains freely, the prevesical space is closed by catgut suture, obliterating all dead space between the symphysis, the fascia and the bladder wall. Then the fascia and muscles are brought together below the tube (Fig. 287) by interrupted chromic gut sutures leaving the tube high up in the wound. The fascia and muscles protecting the peritoneum are likewise sutured with interrupted

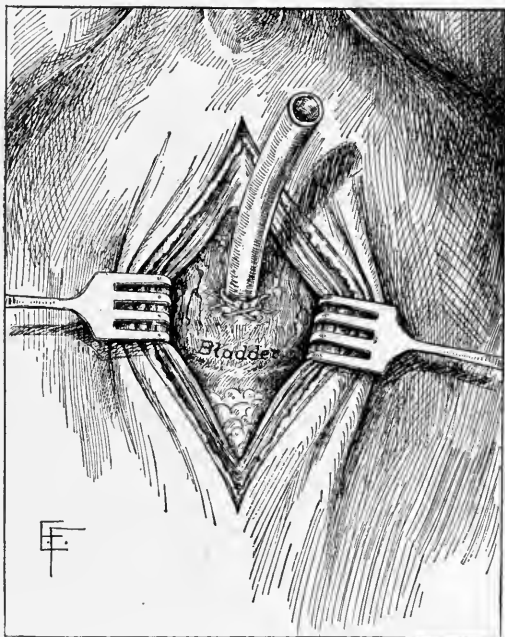


FIG. 283.—Shows the way in which the button drainage tube is fixed into the bladder wound—the stay suture from one side being tied on the opposite side of the tube including some of the bladder wall, and the one from the other side tied in a similar manner. These will hold the tube firmly in place. A purse-string suture is used for the same purpose.

chromic gut sutures, leaving only a little space not closed around the tube (Fig. 288). Then the skin is brought together by interrupted silk sutures (Fig. 289). The drainage tube should be further steadied by fixing it to the skin by means of an adhesive strip (Fig. 290). Then dry gauze dressings are applied and held in place by strips of adhesive tape. (Fig. 290).

The urethral catheter should be removed.

If during the course of the operation the local anesthesia is not sufficient to deaden pain, a general anesthetic should be given. The writer never uses spinal anesthesia in these cases. Some operators, however,

prefer it. The indications for its use are similar to those for other operations on the same subjects.

Following the application of the dressings the patient is returned to his bed.

**The Convalescent Period.**—*Management of the Urinary Drainage.*—As soon as the patient reaches his room the stopper is removed from the drain pipe and the bladder emptied. If there has been only a small amount of residual urine continuous drainage is allowed. If



FIGS. 284 AND 285.—Method of preparing a new site for drainage opening when one has found the first opening in the bladder too near urethral orifice. Finger in bladder locates peritoneal reflexion and with knife and sponge the peritoneal attachments are gradually reflected from bladder and new site selected.

there has been a marked and long-standing distention of the bladder, continuous draining should be avoided, the stoppered drain being opened at intervals of one or two hours as the case demands.

No attempt is made during the first three or four days following the operation to wash or medicate the bladder.

The most marked reaction which follows the operation will become evident from the second to the fifth day after suprapubic cystostomy. The patient, however, is in the best possible condition to withstand this

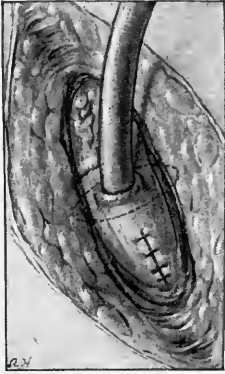


FIG. 286. — First incision closed by suture. Second incision a stab incision through which button drainage tube is inserted. First incision is carefully closed over by prevesical tissues.

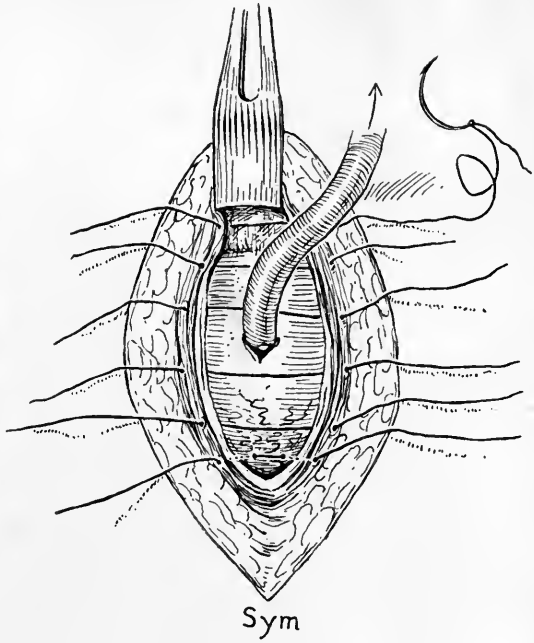


FIG. 287.—Sutures set through muscle and fascia layers.

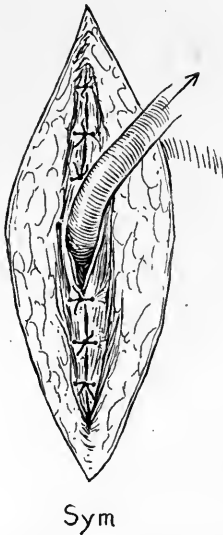


FIG. 288.—Fascia and muscles sutured.

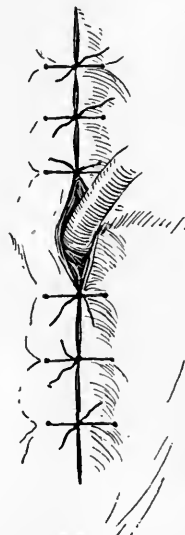


FIG. 289.—The skin suture.

depression, for there has been practically no loss of blood, no general anesthetic, and no special pain, all of which factors tend to decrease the resisting powers of the organism.

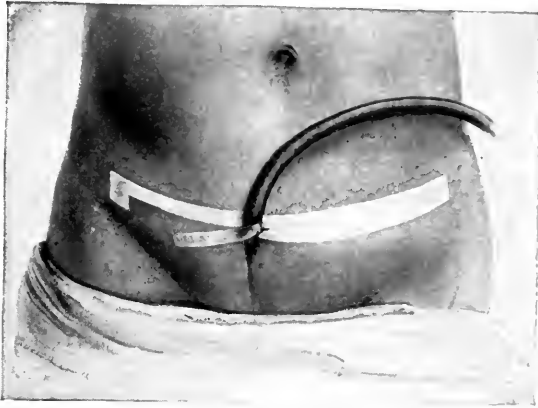


FIG. 290.—Method of securing button drainage tube in abdominal wound to prevent its slipping out or in, and consists of a simple strip of adhesive plaster one piece of which crosses the abdomen and the other piece encircles the drainage tube and then is attached to the abdomen. The condition finally secured is shown in Fig. 291.

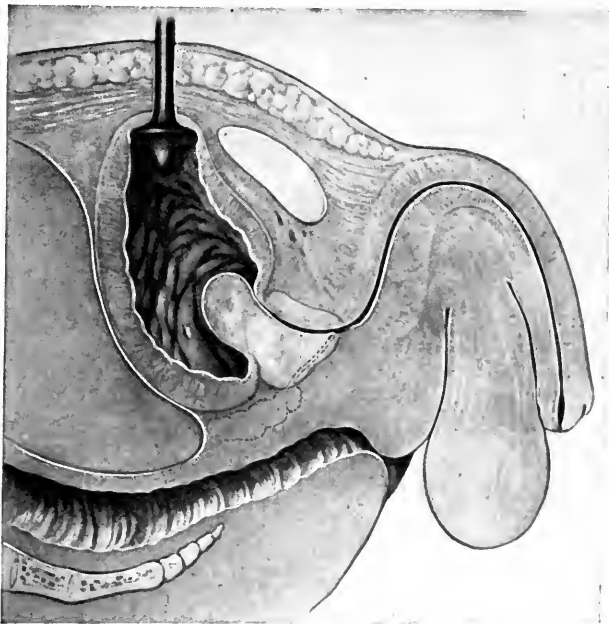


FIG. 291.—de Pezzer catheter in place after suprapubic cystostomy. Button of the catheter fits snugly and is far superior to the ordinary drainage tube inasmuch as it does not permit any rough or sharp surface to irritate the prostate or the bladder wall. This idea was first suggested to me by Rovsing and is the method which he follows.

If the technic of the operation has been carefully followed, there will result a cystostomy opening in which the button drainage tube fits snugly, and being securely held in place prevents any leakage around the tube and at the same time completely empties the bladder.

It has been the experience of the writer in employing this technic that primary union of the wound is secured in practically every case, even where an extensive infection of the bladder exists. The special features which recommend the adoption of this technic, as first described by the writer,<sup>10</sup> are that primary union of the wound is secured with complete control of the urine; further, that the prevesical and perivesical spaces have been eliminated from the surgical problem and half of the operation of transvesical prostatectomy has been completed without the employment of general anesthesia and with freedom from surgical shock.

**Enucleation of the Prostate.**—Many surgeons still proceed with enucleation of the prostate at the time of the primary operation and the method of its accomplishment is practically the same whether it is employed as a primary operation or as a second step following recovery.

*Preparation for the Second Stage.*—When the time for removing the prostate has arrived, the patient is prepared for operation as before. All unnecessary catharsis, etc., on the previous day is avoided. The patient is placed on the table and iodine is applied to the skin around the drainage tube.

*Anesthesia.*—When all is ready the anesthesia is begun. At our clinic we prefer ether administered by the drop method. Here again the principles of anoci-association should be employed, and Lower prefers nitrous oxygen administered by an expert anesthetist. To diminish the shock the finger is introduced into the suprapubic opening and with this as a guide the needle of the syringe containing the novocain is inserted into the prostate and the infiltration is done along the edges of the capsule and into the gland itself (Fig. 277).

In cases in which the period of depression following the first operation is short, *i. e.*, from one to two weeks, it is not necessary to use any instruments to enlarge the drainage opening; the silk skin sutures are still in place and should remain. Where the skin sutures have cut through it is sometimes wise to reinsert heavy silk stay sutures to splint and keep the wound from tearing open during the manipulations necessary for enucleating the prostate. Where a long interval is necessary between the first and second operation, it is frequently of advantage to enlarge the opening.

*Enlarging the Suprapubic Opening.*—This is done as shown in Fig. 292 by three radiating incisions extending on each side of and downward from the opening. These incisions are not necessarily more than an inch in length and are all carried through the subcutaneous fat to the sheath of the rectus muscle.

*Making the Approach to the Prostate Easier.*—If the patient is very stout and the thickness of the abdominal wall leaves the prostate out of our reach, it is desirable to remove sufficient subcutaneous fat to allow

the hand to rest directly against the sheath of the recti muscles. This reduces the intervening space between the hand and the prostate and makes the distance for the finger within the bladder about the same in all cases. In cases where the approach is still too constricted to allow of complete control of the field of operation, the wound is enlarged by carrying the two lateral incisions deeper through the sheath of the recti muscles. Thus, any degree of exposure can be obtained without reopening the prevesical spaces. The incisions are not extended upward on account of the danger of injury to the peritoneum.

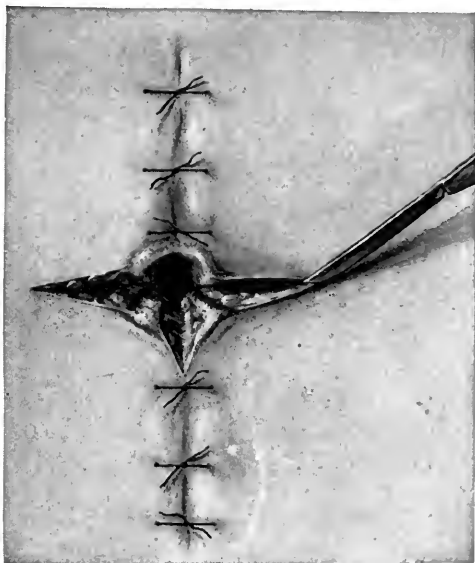


FIG. 292.—Enlarging the suprapubic opening after cystostomy where a nearer approach to the prostate is desired. Note that there are two lateral incisions and one toward the pubis extending only through the fat layer. In doing an enucleation of the prostate the skin sutures remain in place. The wound is not enlarged upward because of the danger of opening the peritoneal cavity.

*The Enucleation.*—With the approach to the prostate provided for, the enucleation of the enlarged portions of the gland is accomplished by entering the index finger of the one hand (or in difficult cases the index and second finger) into the vesical portion of the urethra, slowly dilating it and seeking, if possible, the band-like sphincter vesicae (Fig. 293). Having located this an effort is made first to separate the gland from the encircling sphincter by entering the natural line of cleavage which exists between the hyperplastic glandular masses and the muscular fibers (Fig. 294).

This is of advantage because, *if the internal sphincter is preserved*, the patient will gain control of his urine more quickly and the control will be more perfect; and in the second place, where this muscle is preserved, one seldom has any troublesome hemorrhage

following the enucleation, probably because a rapid contraction of the surrounding tissues takes place. In the case of fibrous or muscular



FIG. 293.—Tip of index finger introduced into vesical portion of the urethra.

hyperplasia this separation of the sphincter is more difficult. In every case *all prostatic tissue should be cleared from the sphincter muscle.*



FIG. 294.—After beginning enucleation of the urethral aspect of the lobe the finger follows the sphincter muscles around the prostatic mass until the prostate is entirely free from it. If this is done before the prostate is removed, the sphincter can be entirely freed from all prostatic tissue and there will consequently be less bleeding.

Having accomplished this, the finger is passed farther into the urethra until the most distant part of the enlarged gland is reached.

Here the lines of cleavage are sought and the enucleation accomplished slowly, gently and completely.

The work of enucleation will be greatly facilitated if the operator introduces one or two fingers into the rectum to lift up and steady the prostate while the enucleation is being accomplished.

*Details of the Prostatic Enucleation*—With the finger in the prostatic urethra, the point of least resistance in the mucous membrane of the urethra is sought. Usually this will be found on the lateral wall of the urethra. At this point the division between the prostate and the urethra is usually quite easily broken through. The finger after entering the line of cleavage sweeps, first, slowly around the distal portion

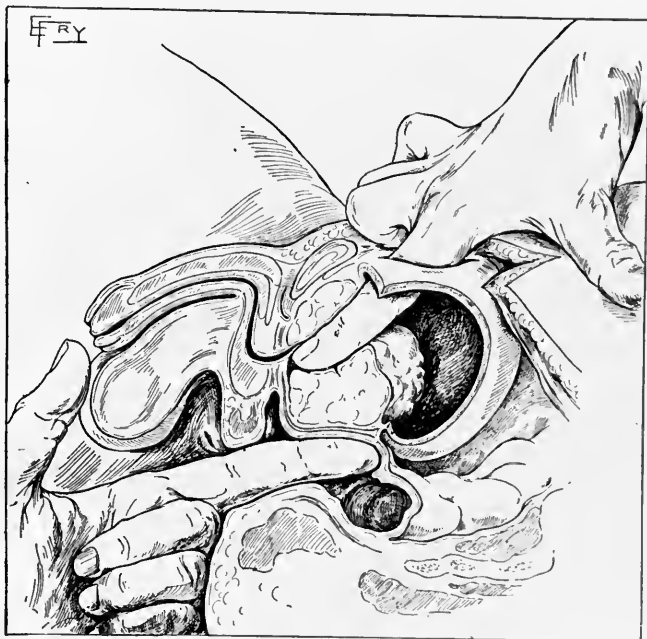


FIG. 295.—Prostate elevated by finger in the rectum; index finger in urethra enucleating the prostate.

of the growth, and then up over the anterior surface of the growth, separating it from the prevesical tissue. The finger is then passed across the urethra to the other side with a sweeping motion and the opposite lateral lobe is freed (Fig. 295). The finger is now passed over the two loosened lateral lobes, then beneath and between them and the rectum, and then the finger is pulled toward the bladder so that the growth will be pushed into the bladder, as is shown more clearly in Fig. 296.

The point which is most difficult to free is that which is most distant from the bladder, at the junction of the prostatic and membranous urethra, or at the point of the attachment of the atrophied middle lobe distal to the ejaculatory ducts which part of that lobe probably

is not removed in the majority of cases. Those cases in which the prostate does not shell out easily should be carefully examined for evidence of malignancy.

A peculiar type of prostate which is occasionally encountered is that in which the gland is enormously hypertrophied in all its parts except the median lobe. In removing such a prostate it may often be more easily done by passing the finger between the sphincter vesicæ and the growth and sweeping the finger around the latter, as recommended by Freyer. It will quickly fall out into the bladder. However, in the majority of cases the intra-urethral enucleation is to be preferred. It is quite essential for the welfare of the patient that all of the prostatic

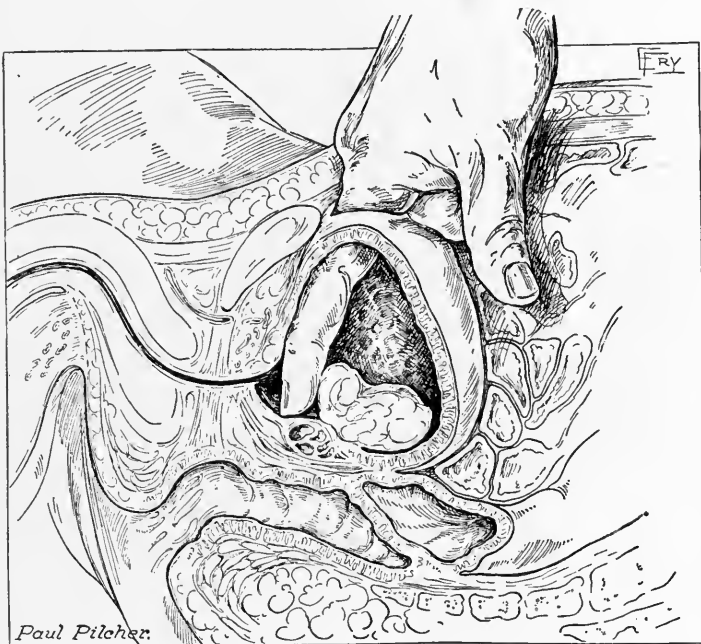


FIG. 296.—Enucleated prostate turned out into the bladder.

tissue as far as possible should be removed. The operator should not be satisfied with removing the larger adenomatous mass alone, but an attempt should be made to bring away all the prostatic tissue unless there is a diffuse carcinomatous involvement. If fragments remain, they retard the healing of the cavity from which the prostate has been removed and are apt to necrose and cause a delay of the healing process.

*Following the Enucleation.*—Remove all foreign material from bladder, *i. e.*, blood clots, the enucleated prostate, loose pieces of tissue, and most important of all, any small prostatic calculi which have been forced into the bladder during the enucleation. Frequently these calculi are overlooked and they may remain and later cause distressing symptoms.

A small gauze sponge is the best instrument with which to remove such calculi.

*The Control of Hemorrhage.*—1. By removing all the glandular masses. This allows the cavity to contract, just as the pregnant uterus does after being emptied.

2. By direct pressure, one finger in the rectum and one in the bladder, placing all torn bits of attached tissue over the lacerated area. Fresh muscle fibers will often seal the opening in a torn vessel.

3. By the bag hemostat. We no longer use gauze packing to control hemorrhage in these cases, because of the large amount of material necessary to secure absolute control of the bleeding, the sloughing of



FIG. 297.—The hemostatic bag of Hagner.

the bladder and wound which may follow its use, the pain and unnecessary disturbance of the healing surface caused by its removal. The hemostat of Hagner<sup>3</sup> provides direct pressure on the bleeding surface by means of an inflatable rubber bag placed within the bladder, the degree of pressure being controlled by a rubber tube which passes down through the urethra, by means of which the bag is inflated and held in contact with the lacerated surface (Fig. 297).

The writer has devised a hemostatic bag of this type which embodies some new features, the object being to increase the comfort and to secure the safety of the patient. In addition, our bag provides for the drainage of the urine through the urethral tube (Figs. 298 and 299).

To place the bag, a well-curved silver catheter is passed through the

urethra into the bladder, after the prostate has been removed until its tip projects through the suprapubic opening. The open end of the urethral tube of the bag is threaded over the end of the



FIG. 298.—The Pilcher hemostatic bag. The device is a simple inflatable rubber bag fashioned about a large size catheter. Cross-section in figure below shows structure of bag. The open tube catheter is entered first through the suprapubic wound over a silver catheter and drawn down through the urethra. When the bag is in the bladder with the tube in the urethra, the bag is inflated through the inflating tube and the inflated bag is used for pressure against the bleeding surface from which the prostate was removed. When pressure is desired the catheter attachment is pulled upon which brings the bag more tightly in contact with the bleeding surface. This pressure may be maintained by attaching the catheter tube to the leg. The catheter tube also acts as an avenue for the escape of the urine from the bladder.

silver catheter and attached there by means of a silk suture passed through the eye of the catheter. The silver catheter is then withdrawn,

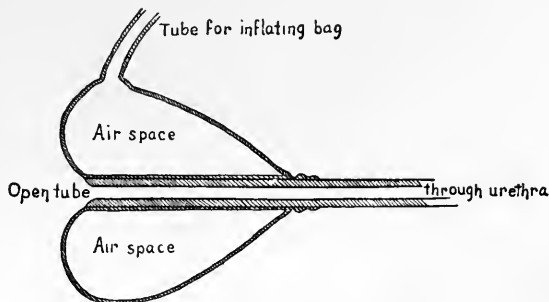


FIG. 299.—Diagram of the Pilcher hemostatic bag.

bringing with it the rubber tube attached to the bag. This tube is then secured, the bag distended with air through the other tube provided for that purpose, and with one finger in the bladder, the

urethral tube is pulled upon, drawing the bag down into the area from which the prostate has been removed; at the same time all tags of tissue and torn muscle fibers are tucked in front of the bag and are brought in contact with the lacerated area (Fig 300). The urethral tube is attached to the leg by means of adhesive strips, completely controlling the degree of pressure desired at the vesical neck (Fig. 301). By this means we have a safe and positive means of controlling hemorrhage which can be removed within an hour, if desired, and reapplied at will,

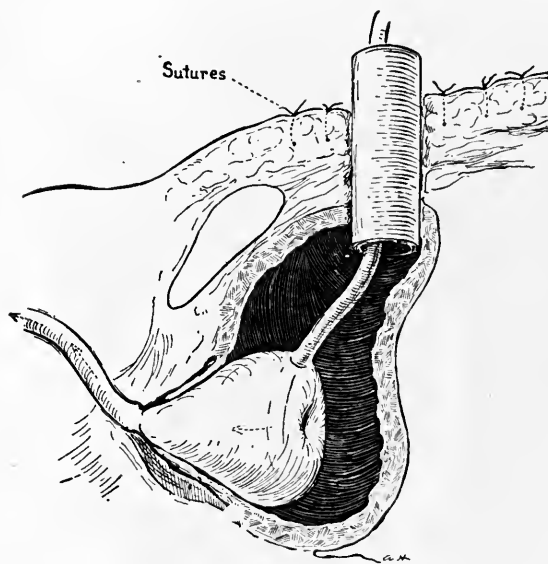


FIG. 300.—Sketch showing complete drainage of bladder with hemostatic bag in place after enucleation of the prostate, inflating tube passing up through or beside large drainage tube. In two or three hours the bag is allowed to deflate and the pressure is relaxed. If bleeding recommences, the bag is reinflated and pressure reestablished. This bag is removed through the suprapubic wound in twenty-four hours.

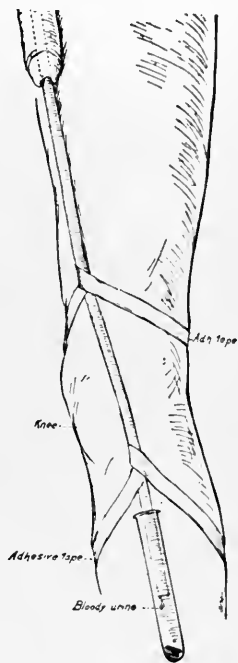


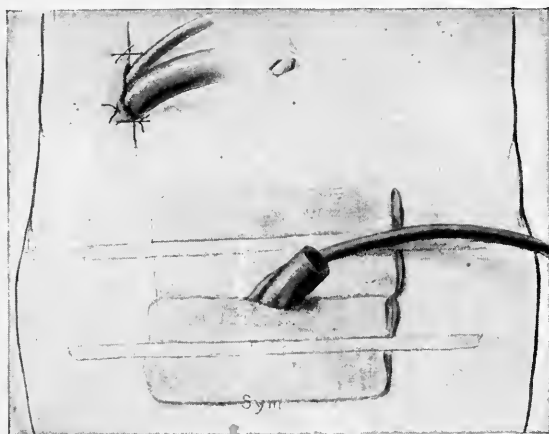
FIG. 301.—Method of attaching catheter tube attachment of hemostatic bag to the leg by means of adhesive plaster to keep up intravesical pressure on the lacerated tissues. Note test-tube over end of catheter to receive urine from the bladder.

without disturbing the patient. Its removal at the same time that the drainage tube is changed is accomplished with relatively little discomfort to the patient.

*Drainage of the Bladder.*—This we consider necessary in every case of transvesical prostatectomy. A large size rubber tube is used, preferably about an inch in diameter. The tube extends only half an inch within the bladder and is fastened to the skin by a silk suture (Fig. 302). If a hemostat bag has been used, the air tube is brought out through the

drainage tube or beside it (Fig. 303). A large size glass connecting tube is attached to the drainage tube and a second rubber tube is attached to it, whereby the secretions from the bladder are collected in a bottle at the bedside. In most cases this will be most satisfactory and the patient will be kept dry for the first twenty-four hours following the enucleation.

*Management of the Bag Hemostat.*—With the bag inflated and in position, we have an absolute control of the hemorrhage. The amount of tension exerted on the urethral tube controls the degree of pressure exerted on the torn periprostatic tissues. It is our practice to exert a considerable amount of pressure for the first hour after prostatectomy. At the end of an hour all bleeding will have stopped. The adhesive strips attaching the urethral tube to the leg are divided, the bag is deflated and it remains in place but exerts no pressure. The urethral



FIGS. 302 and 303.—Surface view of drain and dressing following suprapubic cystostomy in which bag hemostat has been used, the smaller tube being the inflating tube of the hemostatic bag.

tube in the meantime is functioning as a catheter and is draining the urine from the bladder into a bottle. In other words, we have provided a double exit for the urine, and the result is added comfort to the patient, a dry clean wound, and a great reduction in the dressings. If any bleeding should start again it is a simple matter to dilate the bag with air and reapply the pressure. The bag is removed in from twenty-four to forty-eight hours.

*First Twenty-four Hours after Operation.*—If the patient is comfortable and dry and the draining tube is not causing pain or spasm of the bladder, he is not disturbed in any way. If desired, he is allowed to sit up in a chair the day following operation.

If the bag hemostat is causing trouble it may be removed together with the suprapubic drainage tube at the end of twenty-four hours, otherwise it is left in place for forty-eight hours.

*Forty-eight Hours after Operation.*—It is our custom to remove the bag hemostat and drainage tube at the end of forty-eight hours. This is easily accomplished. The distal end of the urethral tube is cleansed and covered with vaselin. The suture holding the drainage tube is cut, and the tube and bag are slowly and gently withdrawn from the suprapubic wound. A long, narrow retractor is immediately placed in the drainage tract to guide us in introducing the button drainage tube. Depending upon the character of the wound we choose a specially made de Pezzer or Pilcher catheter, or a button tube. Grasping the enlarged end of the tube with a pair of dressing forceps it is passed along the groove of the narrow retractor until the end enters the bladder. Then the forceps and retractor are withdrawn, leaving the button end of the tube in the bladder. In most cases the bladder wall will immediately contract and hold the tube in place. In some cases this will take three or four hours. When the tube is in place it is carefully tested by a small amount of irrigation to make sure that it drains the bladder. Frequently some of the irrigating fluid returns around the tube, but in practically every case the greater part returns through the tube, if it is properly placed. When satisfied that the tube is in proper position it is fastened by an adhesive strip (Fig. 290), and attached to an extension tube which is lead to the bottle. In most cases this tube, if correctly placed, will drain all of the urine from the bladder, and after a period of a few hours will keep the patient perfectly dry. This we consider a great advantage to the patient.

At the end of twenty-four hours, some patients, and after forty-eight hours, most of them are allowed to get out of bed. Common sense and not rule governs this phase of the subject.

**Control of the Bladder.**—*One Week after Operation.*—By this time the healing at the neck of the bladder is well advanced, and it is time to think of using the urethra again. (In one of our cases the suprapubic wound healed in four days.) At the end of a week the button drainage tube is still in place, and in most cases the patient is dry. In some cases there will still be leakage beside the tube. When the patient is dry we encourage the use of the urethra. We temporarily close the drainage tube and allow the bladder to partially fill. Then the patient is told to try and void per urethram. It is surprising to note how many will succeed. The majority begin by passing a dram or two each time, every hour a little. At the end of twenty-four hours the patient will be passing an ounce or so every hour and gradually he resumes his natural habit. All of this time we have the drainage tube as a safety valve. In a few days we find that most patients no longer need the tube, and it is removed. Some suprapubic leakage will occur for a day or so, but in many cases there will be very little after twenty-four hours. This depends, however, to a considerable extent on the care and exactness with which the first stage of the operation has been carried out. This refers especially to the placing of the opening in the bladder and the healing of the wound.

The suprapubic opening heals rapidly and, as a rule, is entirely free from the necrotic, phosphate encrusted tissues.

The technic above described is applicable in the majority of cases of prostatic hypertrophy, and when followed will give the patient the maximum of security with the minimum amount of suffering.

The various steps of the scheme can be best seen in review by referring to the chart.

TABLE SHOWING DETAIL OF IMPORTANT PHASES IN A TWO-STAGE TRANSVESICAL PROSTATECTOMY. TECHNIC EMPLOYED BY THE WRITER.

<i>Restoration of Renal Function.</i>	<i>Drainage of Bladder.</i>	<i>Second Operation.</i>
Preferably by means of a suprapubic cystostomy, using button drainage tube (Fig. 282); local anesthesia.	All urine collected through tube; no urinary leakage around tube; patient dry out of bed on second day.	Transvesical finger enucleation of prostate; ether anesthesia five to ten minutes.
<i>First Twenty-four Hours after Operation.</i>	<i>Second or Third Day.</i>	<i>Third to Seventh Day.</i>
Patient dry; urine drains through suprapubic tube and urethral tube if employed.	Primary suprapubic tube out and replaced by button drainage tube; hemostat bag removed; patient wet for two to three hours.	All urine coming through button drainage tube; patient dry; out of bed.

#### CONTROL OF BLADDER.

<i>Seventh Day.</i>	<i>Eighth to Tenth Day.</i>	<i>Eleventh Day.</i>	<i>Thirteenth to Twentieth Day.</i>
Control of bladder begun; with drainage tube temporarily closed during day, urination per urethram is begun; every hour at first; patient dry.	Control of bladder continued; gradual lengthening of interval between urination to three hours; patient dry.	Wound well cicatrized; button drainage tube removed; urination continues; slight urinary leakage.	Sinus healed.

*Control of Hemorrhage.*—In addition to the methods already described for controlling hemorrhage the following means have been employed.

*Fenwick Method by Clamp and Ligature.*—Fenwick has devised a series of three specula of different sizes which may be introduced through the suprapubic wound, bringing the area from which the prostate has been removed directly into view. The use of one of these specula is illustrated in Fig. 304. The headlight is used to illuminate the cavity. With the lacerated oozing area in view and properly illuminated, the area is sponged as dry as possible and it will be found, as a rule, that bleeding does not come so much from the cavity from which the prostate has been removed, but usually from the free edges of the lacerated tissue which covers the surface of the prostate on its vesical aspect. The area from which the prostate has been removed flattens out very quickly and does not remain as a cavity, but contracts and, usually, does not allow space for the accumulation of blood clots. Through the speculum the bleeding points are caught with specially devised hemostats. In this way the bleeding can be entirely controlled. In most cases after a few minutes' crushing with the hemo-

stats they may be removed and no further bleeding will occur. The hemostats are so constructed that the handles may be removed, if necessary, and the instruments may be left *in situ* for twenty-four hours.

As a modification of this method the writer would suggest the use of the actual cautery through the speculum to control any bleeding-point which might come into view.

*Control by Suture.*—A number of prominent operators complete their prostatectomies by surrounding the area from which the prostate has been removed by a continuous or by interrupted catgut sutures. This necessitates a large suprapubic wound and consumes considerable time and, in the experience of the writer, has never been found necessary.

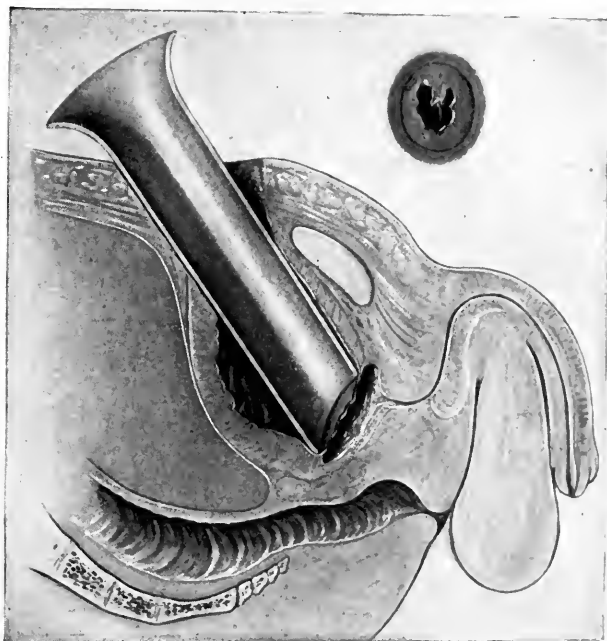


FIG. 304.—The Fenwick bladder speculum in place.

*Control by Pressure.*—With one finger in the rectum and a finger in the bladder the tissues involved in the prostatic wound may be pressed together and in this way much oozing will be prevented. At the meeting of the American Urological Society in Boston, April, 1913, the writer presented a method of controlling hemorrhage, using gauze packing. This consists of introducing a catheter through the urethra which serves as a staff around which the packing is to be placed. Then a narrow strip of gauze is introduced through the suprapubic wound and the torn edges of mucous membrane which have been stripped up from the prostate are pressed down into the shallow prostatic pouch and held in place by gauze packing, as is shown in Fig. 305. This shows the prostatic pouch exaggerated, with the torn

flaps of mucous membrane pushed before the gauze packing and in addition a de Pezzer catheter used to hold the gauze packing in place. This de Pezzer catheter may be introduced by first passing a silver catheter through the urethra and out through the suprapubic wound, then attaching the small end of the de Pezzer catheter to the silver catheter and drawing it out through the urethra. With the expanded end of the catheter on the vesical side of the packing considerable pressure may be brought to bear, using a very small amount of gauze packing by pulling on the outer end of the catheter. Up to the present time we have always used the simple rubber catheter as a staff around

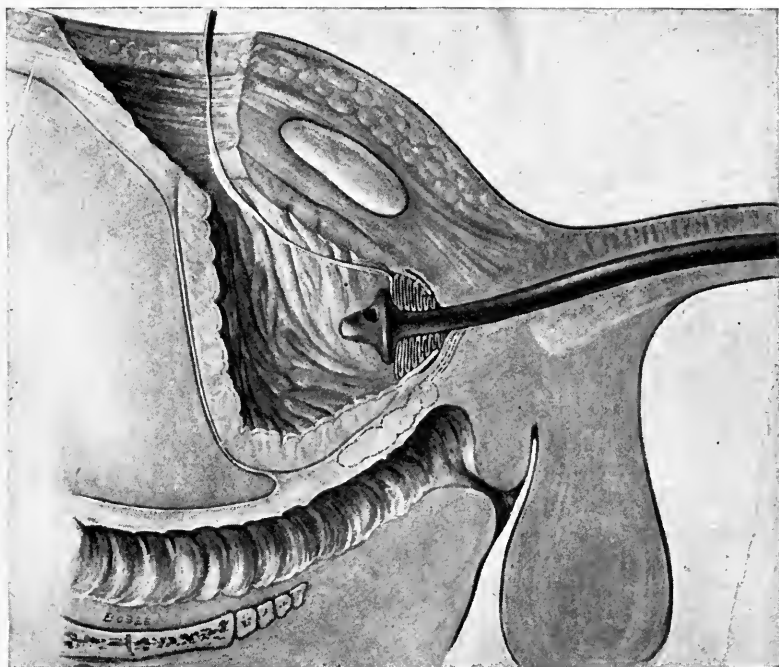


FIG. 305.—Bed of prostate packed with gauze around catheter à demeure.

which to pack the gauze. The end of the gauze is led out through the abdominal wound. The bag hemostat, however, has been found to be the best method of controlling the bleeding.

*Control of Secondary Hemorrhage from the Bladder.*—Hemorrhages occurring within twelve to twenty-four hours after the prostatectomy are best controlled by packing the prostatic pouch around a catheter introduced through the urethra. In one case the writer passed a silk suture through the perineum, placed a gauze packing over the prostatic pouch and fastened the silk suture to this gauze packing, tying the same on the outside of the perineum. *Secondary hemorrhage which occurs a week or so after the operation* may be either from the wound itself which calls for its reopening and suture, or it may be from the

vesical neck or the prostatic pouch itself. Such an occurrence calls for reopening of the bladder, exposure of the bleeding-point and securing it either by suture or touching it with the actual cautery or the high-frequency spark generated from the D'Arsonval current. In one case of my own it was necessary after the second week to reopen the bladder widely and cauterize the entire area of the vesical neck before the hemorrhage could be stopped.

**Variations in Technic.**—*The Trocar and Cannula for Suprapubic Drainage of the Bladder.*—This technic has been recently worked out by Lower,<sup>5</sup> of Cleveland. He describes it as follows:

Using a local anesthetic, or without any anesthetic even, the trocar and cannula may be forced into the bladder at a point sufficiently distant from the pubis to avoid puncturing the plexus of veins which lies just behind the pubic bone. The trocar is then withdrawn, and a sterile No. 14 soft-rubber catheter is inserted through the cannula into the bladder. The cannula is withdrawn and the bladder emptied

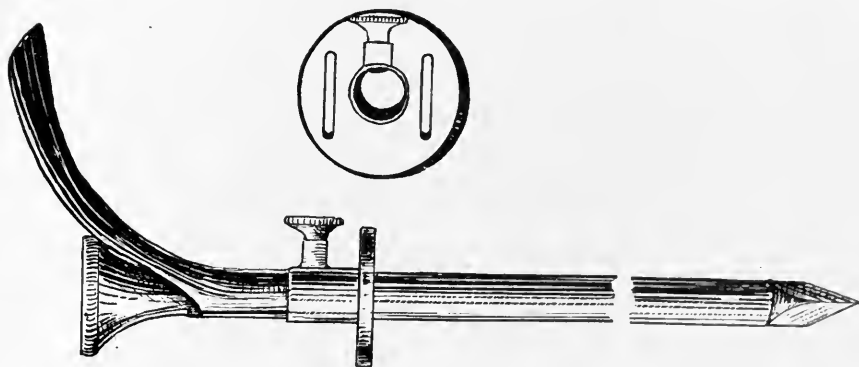


FIG. 306.—Trocar and cannula with metal collar. (Lower.)

through the catheter, which is allowed to remain. The retained catheter can be held in place by adhesive plaster, the end being plugged or compressed until relief is again needed. The catheter may remain in place for days, if necessary, without doing any harm and in the meantime the patient can be made ready for operation or further treatment. It may happen that after several days of suprapubic drainage the patient will again be able to void urine. This method often is a more comfortable way of securing continuous drainage of the bladder as a preparation for prostatectomy than is the insertion of a catheter through the urethra, as the latter method is generally irritating and disturbs the patient greatly.

If no soft catheter of the proper size is available the cannula itself may be retained, if it is fastened with tape inserted through the small slits in the collar. The writer has never seen a permanent fistula follow the use of the trocar.

This method is not recommended to replace the preliminary cystos-

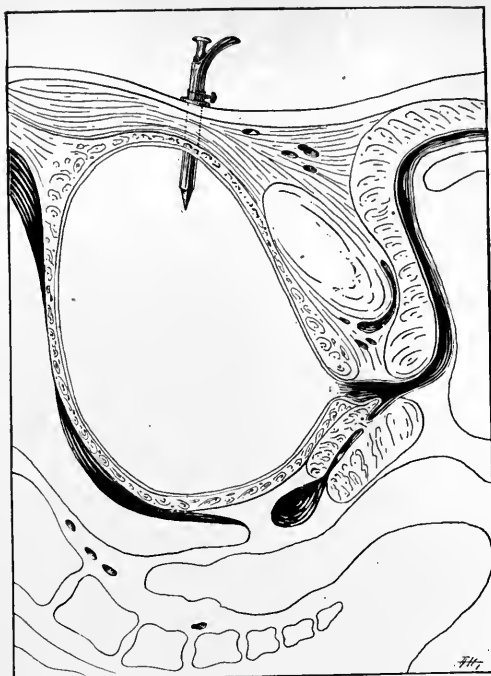


FIG. 307.—Introduction of trocar. (Lower.)



FIG. 308.—Introduction of catheter through cannula. (Lower.)

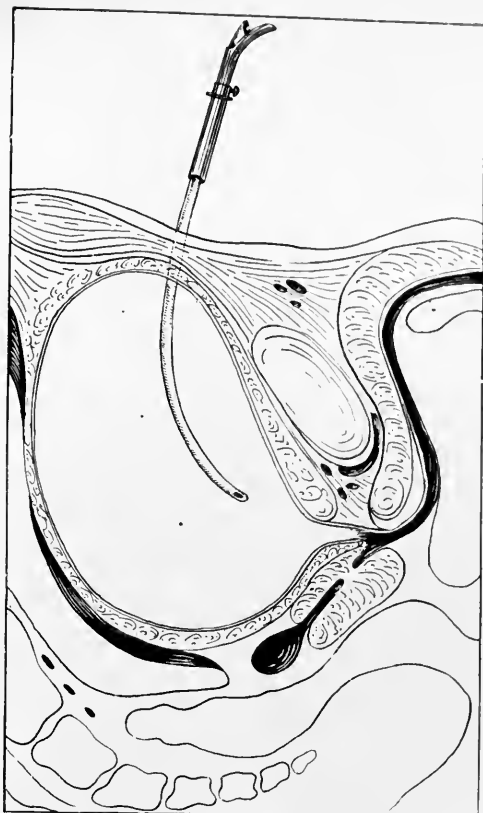


FIG. 309.—Cannula withdrawn. Catheter remaining. (Lower.)



FIG. 310.—Cannula fastened in and secured by tapes through small openings in the metal collar. (Lower.)

tomy, for two reasons: First, the opening in the bladder is too low down; and second, because the opening is not large enough to permit removal of the prostatic growth.

The bladder should be full when the trocar is inserted into it.

**Transvesical Prostatectomy by the Open Method.**—Many operators still prefer to complete the operation of transvesical prostatectomy in

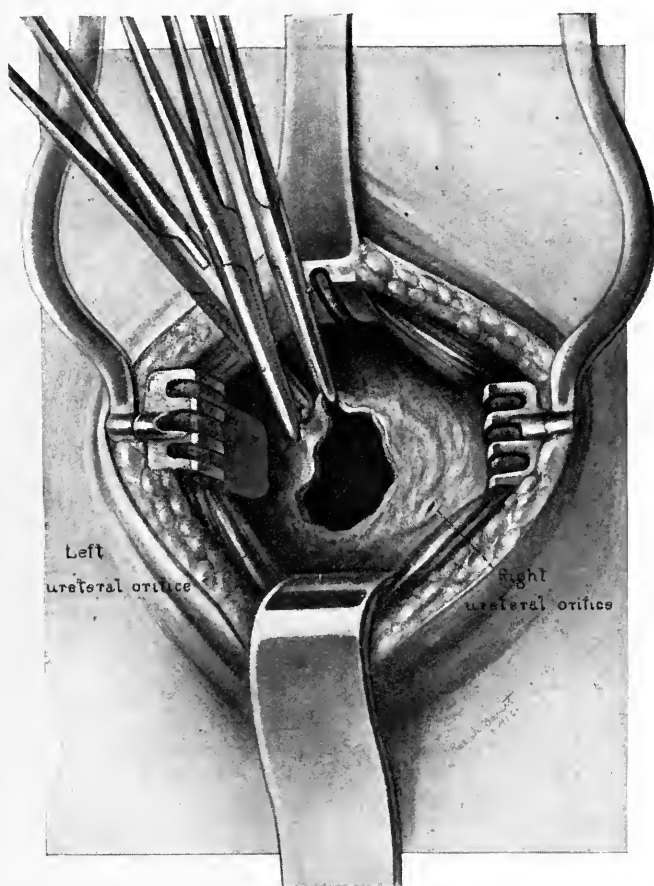


FIG. 311.—Cavity left after removal of prostate and bladder caught preparatory to suturing. (Judd.)

one stage, always, however, preceded by a period of preliminary treatment of intermittent catheterism or permanent bladder drainage through the urethra. Our objections to this have already been noted. There are those also who prefer the open method of prostatectomy even after preliminary suprapubic drainage, either by the method of cystostomy, or the introduction of a suprapubic tube through a trocar opening.

Either through a primary incision or by enlarging the opening which already exists, the interior of the bladder is exposed. The bladder wall is cut sufficiently to give a good exposure of the vesical neck, care being exercised not to carry the incision too near the urethral opening. Suitable retractors are introduced. Then using a large syringe, a solution of novocain 0.25 per. cent. containing a small amount of adrenalin is injected into the prostate especially at its periphery. This

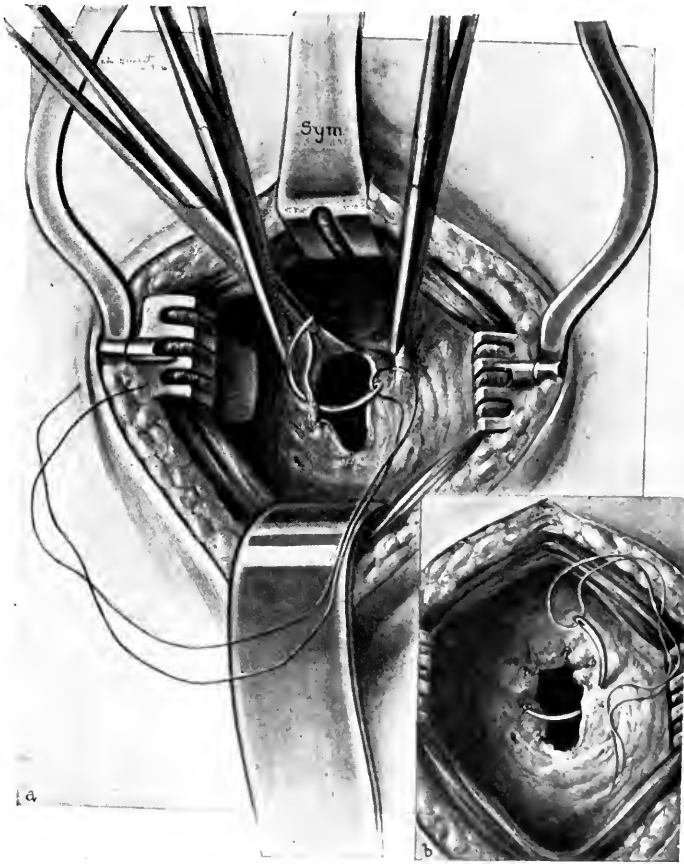


FIG. 312.—*a*, prostatic capsule partially closed by interrupted suture; *b*, sutures in place investing mucous coat. (Judd.)

tends to block the nerves and the enucleation may then be done in a number of different ways. Some operators prefer to incise the mucous membrane over the more prominent portions of the gland and the separation of the mass is started with a blunt dissector or the gloved finger. The technic of Dr. Judd, of Rochester, Minn., is most excellent. He grasps the prostatic mass with forceps, when possible, and lifts it up, at the same time using one or two fingers to free it from the bladder wall and sphincter muscle. From here on the method of

enucleation is practically the same in all cases, the prostate being shelled out by forcing the finger between and around the enlarged lobes and turning them out into the bladder. After the mass has been removed from the bladder, the lacerated area is inspected and if any

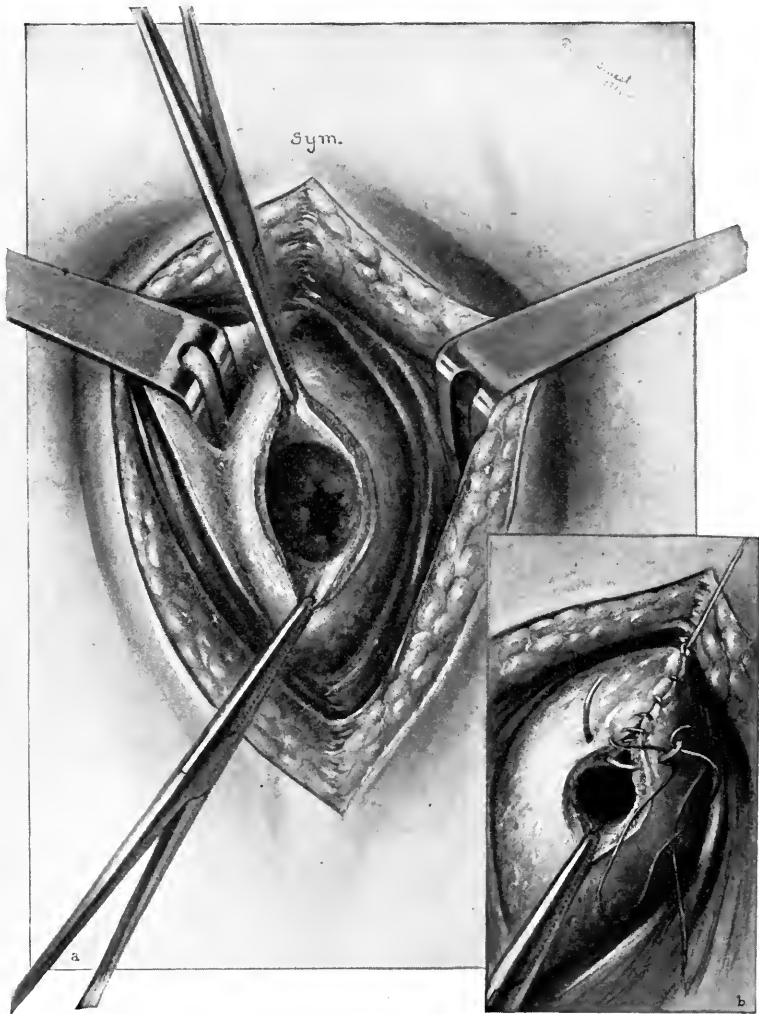


FIG. 313.—*a*, self-retaining retractors removed and roof of bladder ready for closure; *b*, bladder closed with continuous suture of chromic catgut, avoiding mucous coat (Judd.)

spurting vessels are seen, these are secured and tied with catgut (Fig. 311). As a routine, Judd places a few sutures of chromic gut through the bladder wall, including the depths of lacerated tissue on either side of the lacerated posterior urethra, and ties them, thus controlling the oozing surfaces and the cut edges of the bladder mucous membrane

(Figs. 311 and 312). Most operators prefer to close the suprapubic wound around a drain of large calibre to prevent the accumulation of blood clots. In selected cases where the hemorrhage seems to be controlled, Judd prefers to insert a catheter through the urethra and close the suprapubic wound entirely. In his hands this method seems safe, but as yet the writer feels that it cannot be recommended for general use. The after-care is the same as in the two-stage operation.



FIG. 314.—Perineal prostatectomy, primary incision.

**Technic of Perineal Prostatectomy.**—*Before the Incision*—The patient is placed on a firm table in an exaggerated lithotomy position, the pelvis elevated by sand-bags or other special supports to a degree that will bring the plane of the perineum as nearly horizontal as possible. The rectum should have been emptied by an enema administered at least eight hours before the hour of operation. The scrotum, perineum, and adjacent thigh surfaces having previously been shaved and cleaned, should again be scrubbed and disinfected after the patient has been placed in position. A full-sized sound, No. 26 to 30 (French), should be introduced through the urethra into the bladder and held by an assistant. Should strictures in the anterior urethra be detected,

they should be freely divided by a urethrotome at this time. The sound in the urethra should not be made to project into the perineum, but should be raised so as to bring the membranous urethra as close as possible to the pubic arch and increase the distance between the urethra and the rectum (Proust).

*The Primary Incision.*—A curved incision through skin and superficial fascia is then made, distant an inch to an inch and a half in front of the anus and extending from ischium to ischium (Fig. 314).

*The Exposure of the Recto-urethral Muscle.*—This is a step of the highest importance, since this semi-aponeurotic muscle is the only real barrier in the way of free access to the periprostatic space. By its



FIG. 315.—The bulb of the urethra exposed.

prolongation anteriorly the membranous urethra is swung from the pubic arch and its main portion, inserted into the anterior wall of the rectum above the internal sphincter, draws that portion of the rectum forward toward the urethra; in many instances in the aged the bulb is so enlarged (Fig. 315) that its backward projection is sufficient to cover entirely the space between rectum and urethra. The delimitation of the bulb is quickly accomplished after the division of the anobulbar raphe. The bulb is then drawn forward in the grasp of a forceps until the membranous urethra is identified, distended as it is by the sound that fills it, but obscured by the recto-urethralis muscle. As the bulb is drawn forward the posterior edge of the transverse perineal muscle

on each side is made tense and identifiable, and is a guide to the location of the artery of the bulb which is to be avoided. Just behind these transverse fibers and vessels to the outer side of the urethra is a weak spot in the deep perineal fascia through which the tip of the finger can readily be made to bore, and to penetrate alongside the membranous urethra as far back as the prostate. The finger-tip thrust in at this point pressing outward and backward toward the ischia quickly opens up these lateral spaces, into which suitable retractors are placed.

*The Exposure of Prostate.*—The detachment of the recto-urethral fibers from the face of the membranous urethra is now readily effected, guided by the eye and aided by the scissors or the knife, but for the most part bluntly done by the finger. The rectum, now freed from its anterior attachments, is pushed backward; the connective tissue about the urethra and the face of the prostate is readily detached and rolled back by the finger-tips until the rectoprostatic space is penetrated as deeply as the conditions may require. A broad, blunt-edged retractor is adjusted so as to keep the rectum drawn back from the field and, with the assistance of the lateral retractors already placed, the prostate is fully exposed. The description of the operative steps thus far may have seemed long, but the work itself advances steadily from point to point, and does not take much time for its accomplishment. (In the experience of the writer from ten to twelve minutes.)

*The Downward Traction of the Prostate.*—The prostate may be forced down toward the perineal surface by strong pressure from above the pubis, or it may be seized by suitable traction forceps introduced through the perineal wound and dragged down so as to be more accessible to attack; but it is better done by tractors which are introduced through the membranous urethra into the bladder and by opening their intravesical blades whereby strong traction can be exercised upon the base of the bladder. Such are the tractors of Lydston, Syms, de Pezzer and Young (Figs. 316, 317, 318 and 319). Of these we have used with great satisfaction the model devised by Young. The time for its introduction is after the prostate has been fully exposed, as described in the preceding paragraph. The membranous urethra is also fully exposed in the wound distended by the sound, which now serves as a guide by which to incise the prostatic urethra, beginning at the apex of the gland and extending the incision as far backward as may be necessary to give room for the ready introduction of the rather blunt and clumsy beak of the tractor. After the incision has been made the sound is withdrawn, the edges of the incision are held apart by tenacula or loops of thread that have been inserted into them, and the tractor passed through the prostatic urethra into the bladder. Its blades are then rotated so as to form two divergent wings within the bladder, by means of which traction is made with a minimum of injury to the mucous membrane of the bladder. Such an instrument is more than a tractor; it is practically an elongated finger by means of which the operator can appreciate to a



FIG. 316.—Young's prostatic tractor (open).



FIG. 317.—Young's prostatic tractor (closed).



FIG. 318.—de Pezzer's tractor (open).



FIG. 319.—de Pezzer's tractor (closed).

notable degree the conditions within the bladder, can make such graduated pressure as he may require to facilitate the progress of the enucleation, and can gauge the extent of his work at any time. It contributes to a notable degree to the positiveness and accuracy of the work.

*Enucleation of the Gland* (Figs. 324, 325, 326, and 327).—To effect this the technic described by Young will be found to be very satisfactory. The prostate having been brought forward and exposed, two free longitudinal incisions are made through the capsule to a depth of about one and a half centimeters into the substance of the gland (Fig. 320), one on either side of the urethra. These are about one and a half centimeters apart in front and diverge slightly as they pass backward. The



FIG. 320.—The enucleation of the prostate.

bridge of tissue that lies between them supports the urethra and contains the ejaculatory ducts. The outer edge of one of the wounds in the capsule is then seized with forceps to steady it, and a blunt dissector entered in the line of cleavage that presents; with this the lateral lobe is readily enucleated anteriorly and externally; the partially turned-out mass can be seized with suitable traction forceps and pulled upon to facilitate the separation of the deeper portion. The finger-tip may now be substituted for the blunt dissector as the enucleation extends into a region beyond the control of the eye. As that portion of the mass is reached which lies adjacent to the urethra it should be separated with especial care to avoid tearing the urethra; the blunt dissector, the touch of the knife point, or a snip of the scissors may be required to divide the bands of tissue that unite

it to the urethral wall. The other lateral mass is then removed in the same manner. *The presence of a median lobe* is then readily determined by the combined manipulation of the finger-tip in the lateral prostatic cavities and the tractor in the bladder, and if present may be brought down within reach of the enucleating finger with marked ease by the pressure of the suitably placed intravesical blades of the tractor, freed and turned out through one of these lateral spaces without injury to the bladder, and in many cases, it is believed, without injury to the ejaculatory ducts. If palpation reveals now the further presence of a mass in the posterior median bridge still left, it can be exposed by transverse incision and enucleated, but such removal would entail cutting across the ejaculatory ducts. *In the relatively small, hard, fibrous prostates* the enucleation of the small glandular nodules may be readily accomplished, but for the removal of the greater part of each lobe there is required piecemeal excision by traction forceps and scissors.

The operator will be able to determine with great facility and accuracy the thickness of the tissue intervening between the depth of his dissection and the cavity of the bladder by the tip of his finger in the wound pressed against the broad blades of the tractor in the bladder. By the tractor also, used as a searcher, for which its shape well fits it, the presence of calculi in the bladder will be determined. If a calculus is present it is to be removed through the prostatic urethra by the appropriate instruments required for the purpose.

In cases of *fibrous contracture of the internal meatus* an incision of the floor of the prostatic urethra through the ring into the bladder should be made.

If a *pedunculated median intravesical growth* is found that cannot readily be everted into a lateral cavity, the prostatic urethra should be incised backward sufficiently to allow of the tumor being caught and brought out into the urethral wound and cut away.

*The Primary Wound Dressing.*—The tractor having been withdrawn after the blades have been closed, all clots are cleared from the bladder by irrigation. Then a permanent catheter preferably of large size of soft rubber is tied into the bladder through the entire length of the urethra. This is to remain for a week. The peri-urethral tissues are sutured around this catheter, using several sutures of chromic catgut. The deep urethral spaces of the wound are brought together by sutures of chromic gut around a small tampon of silver nitrate gauze and a short rubber drainage tube which extends to the deepest part of the wound cavity. The tampon and the tube are removed on the third to the fifth day, at which time the cavity is irrigated. The urethral catheter is removed on the seventh day. The superficial parts of the wound are sutured with silkworm gut around the drainage. The results following this method of after-treatment have been highly satisfactory. The perineal wounds have rapidly closed; permanent fistulæ are of very rare occurrence; the ability of the bladder to retain and expel its contents at due intervals is early regained, with the reservation as to some instances of temporary defects in reten-

tion; and no strictures of the urethra have developed in the writer's experience. In some cases we simply place a large rubber drain tube through the opening in the prostatic urethra into the bladder and secure its outer end at one angle of the external perineal wound (Fig. 321) by a point of suture, at the same time laying a gauze tampon in the depth of the perineal wound. The tampon is removed on the fifth day, the bladder drained on the seventh day, when, after an irrigation of the bladder and urethra, a sound is passed through the urethra into the bladder. The later history of these cases has been quite as favorable as those in which the preceding method of operation was employed, and, as the method is more simple and less irksome to the patient, we are inclined to regard it as to be preferred, unless further experience should show it to be attended with greater liability to the development of distortions or strictures of the urethra.



FIG. 321.—The perineal wound closed.

*After-treatment.—Local.*—The local cares are very simple, relating merely to those of any drained wound, plus the provisions for carrying away the urine. To the retained catheter is attached a sufficient length of rubber tubing to reach a bottle hung at the side of the bed, which receives the urine conveyed through the tube. An absorbent compress to the perineal wound, retained by a T-bandage, constitutes the dressing. The removal of the gauze tampon on the fifth day, and of the drain or catheter on the seventh day, and the opening of the urethra by sound, have already been discussed. Instrumentation applied to the urethra or the wound cavity should be avoided as far as possible; but such a minimum use of the sound as may be required to

assure the surgeon of the continuity and full patency of the urethral canal should not be omitted.

The treatment of a complicating cystitis should receive such attention as the condition of the particular patient may determine. Continuous irrigation of the bladder after operation is seldom indicated.

*General Considerations.*—The aged men who are subjected to perineal prostatectomy bear the operation, as a rule, surprisingly well, even though the manipulations seem to be somewhat prolonged. This I take it is due to the little loss of blood that attends the work, and to the elevated position of the pelvis and lower limbs which is maintained during its progress. In the feebler patients, however, a later depression has in some cases manifested itself after the operation. This, however, soon disappears under the use of heat, hypodermoclysis, and adrenalin.

The same tendency toward renal insufficiency occurs after the perineal operation as after the transvesical and should be guarded against by preliminary treatment.

*Results of the Perineal Operation.*—The best results that can be expected in the most expert hands are an immediate mortality of between 3 and 6 per cent. In a series of twenty-one cases of our own, men ranging from fifty-five to eighty years of age, there were two deaths—9 per cent. mortality.

*Relief of Obstruction.*—In our own series of cases we had complete and permanent relief of obstruction with the exception of one case which was of the contracted fibrous type, in which we did not entirely remove the obstruction.

*Fistulæ.*—A persistent recto-urethral fistula remained in one of our cases. In all of the others complete and sound healing of the wound took place.

*Epididymitis.*—This occurred six times in the course of healing in a series of twenty-one cases.

*Continence of Urine.*—The control of the bladder sphincters preventing involuntary escape of urine is regained in great measure within from ten to twenty days after operation. Some weakness of the sphincters, resulting in slight leakage, if the patient cannot at once respond to calls to empty the bladder, continues to manifest itself for months in some cases, but is gradually replaced by normal control in most of the cases. In some instances, however, this weakness continues permanently, but entails an infirmity so much less than the preëxisting dysuria that the patient bears it cheerfully.

*Conclusion.*—In our own experience the results have justified the expectations which the representations of other surgeons have created and the perineal operation may be considered as a fairly safe and reasonably certain means of relief. It is necessary, however, that the operation be done by a surgeon of experience and that he should employ a full exposure of the gland in the wound at operation. As an operation to be performed by the general surgeon it cannot be compared in safety, in freedom from accidents and in the certainty of the results, with the two-stage transvesical prostatectomy.

**Perineal Prostatectomy through a Median Incision.**—*Finger Enucleation through an External Perineal Urethrotomy Incision.*—This method has been extensively practised and is strongly recommended by Watson<sup>18</sup> as the preferred method in the majority of cases.

*Technic.*—A vertical median incision is made similar to the one used in performing a median perineal external urethrotomy. The dissection exposes the anterior end of the membranous urethra. Watson describes the steps of the operation as follows:

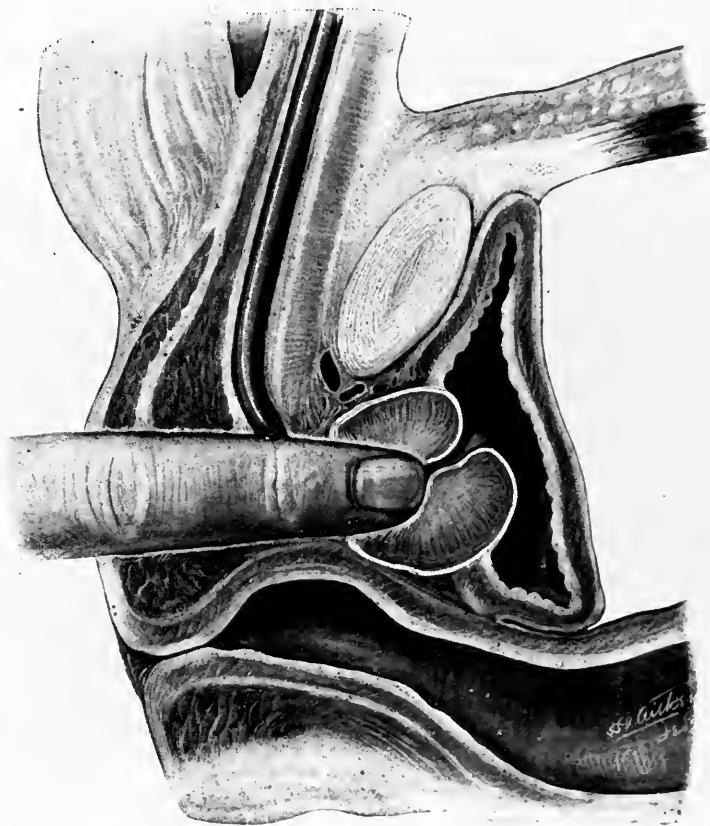


FIG. 322.—Finger introduced into the prostatic urethra and about to begin the enucleation. (Watson.)

*Operation.*—Pass the grooved staff into the bladder and make it prominent in the middle line of the perineum. If there is special difficulty in passing the sound into the bladder, because of the obstruction offered by the prostate, it should not be carried beyond the posterior end of the membranous urethra. This serves the purpose for which the sound is used just as well as though it were passed into the bladder (Figs. 322 and 323).

Expose the bulbous and the anterior part of the membranous urethra by a median incision. Open the posterior end of the membranous and anterior end of the prostatic urethra by a straight, narrow bistoury, using the nail of the index finger placed in the groove of the staff as



FIG. 323.—Enucleation through a median external perineal urethrotomy incision.  
(Watson.)

a guide. The cutting edge of the knife should be directed upward. Withdraw the staff. Pass into the incision in the urethra and through the prostatic urethra into the bladder three steel sounds, the little finger, and the index finger in succession (see Fig. 322).

Push the prostate toward the surface of the perineum and maintain it firmly in this position by strong downward pressure upon the abdominal wall made by the hand of an assistant.

The index finger is pushed into the prostatic urethra and turned upward so that its dorsum rests on the floor of the canal (Figs. 322 and 323).



FIG. 324.—Young's technic: Prostate brought down and lateral incisions made in capsule. (After Young.)

Press the finger-tip against the side of the urethra above its floor and make an opening about midway in its length, through the urethra and all tissues intervening between it and capsula vera of the lobe of that side of the gland.

Proceed to enucleate thus: Pass the finger-tip beneath the posterior surface of the lobe, between it and the outer fibrous sheath (Fig. 323), and break down the fibers attaching it to the gland. Carry the finger

over the outer and superior aspects of the lobe as far as the middle line above—*anterior commissure*. Go back and free the aspect of the lobe from its attachment to the *triangular ligament*. Then separate the base of the lobe from the floor of the bladder and its outlet. If the gland is to be removed one lobe at a time, break through the *anterior commissure* and separate what remains attached to the *prostatic urethra*. This leaves the first lateral lobe free. Apply forceps to it and gently withdraw it through the external incision.

If the two lobes are to be removed in one mass, the finger-tip passes over the *anterior commissure*, instead of breaking through it, and

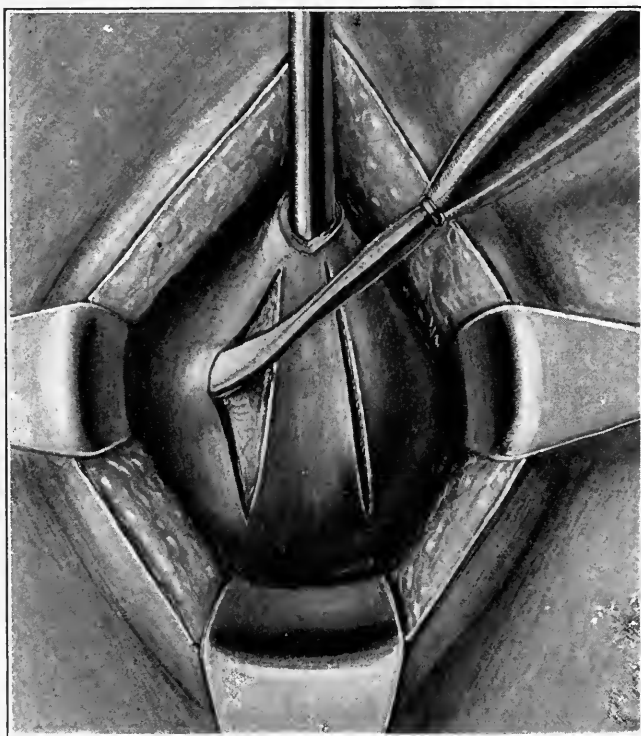


FIG. 325.—Young's technic: Separation of capsule with blunt dissector. (After Young.)

repeats the same maneuvers with the second lobe that were employed to free the first one. Care should be taken to avoid, so far as possible, laceration of the *membranous urethra* in withdrawing large masses through the external wound.

If a middle lobe is present, the mucous membrane covering it should be split, scratched, or cut through, either in the middle line above or along one side of the enlargement, and enucleated with the finger, the lobe cut away with scissors, or snared off. It can be brought within reach of the finger-tip by downward pressure from above the *symphysis* upon the external surface of the abdomen, as in the case of the lateral lobes,

or, after the latter have been removed, it is readily hooked down with the finger-tip.

The methods of drainage of the bladder and wound are similar to those recommended in the other type of perineal operation.

This method of removing the prostate does not recommend itself to the majority of surgeons.\* It is more difficult of performance, more uncertain in the completeness of its removal of the obstruction, and the chances of accident and unpleasant sequelae are far greater than is the case in a properly executed transvesical prostatectomy.

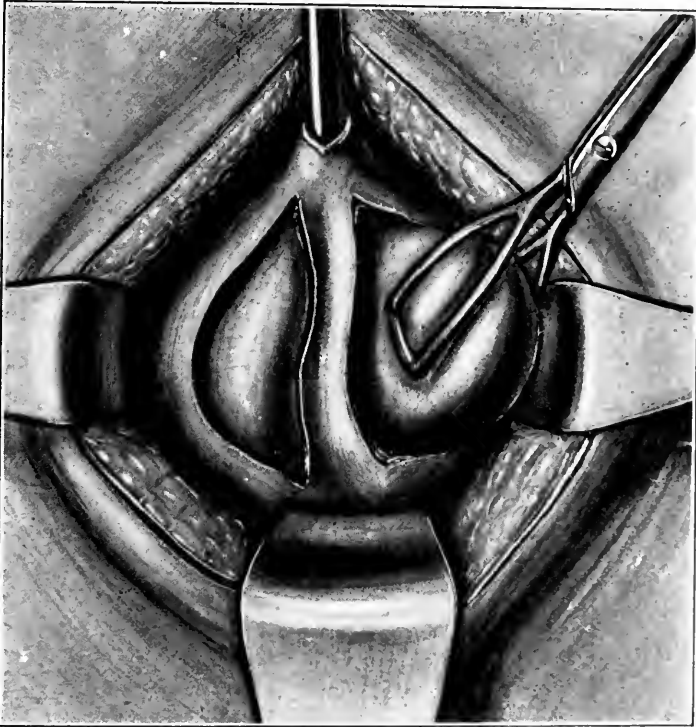


FIG. 326.—Young's technic: Withdrawing lateral lobes after being enucleated.  
(After Young.)

**Difficulties Encountered during the Course of Prostatectomy.**—Difficulties in the approach to the prostate are problems of general surgical interest and do not need special mention here, but there are a small percentage of the cases (not more than 10 per cent. and not less than 5 per cent.) in which irregularities in the form and attachments of the hyperplastic tissues are such that their safe and complete removal requires all the ingenuity that an experienced surgeon can

\*This is partly because of it being performed by the sense of touch alone and partly because it is thought by many that its final results are not as good as those attained by other technics. It is, however, as safe and complete as any of the methods.

apply. The writer has been surprised to learn from time to time that surgeons have contented themselves in difficult cases with a partial removal of the prostate, not feeling sure at the end of a difficult attack that the obstruction itself has been in any way relieved. This is almost inexcusable today, unless the case is unquestionably one of malignant infiltration. Under difficult conditions where the finger enucleation has proved unsatisfactory, the bladder should be widely opened and the prostatic area exposed, and a careful dissection made of the obstructing mass irrespective of whether or not



FIG. 327.—Young's technic: Manner of removing middle lobe. (After Young.)

the internal sphincter of the bladder is removed. It is better to remove the internal sphincter with an adherent infiltrating mass, even though it might result in a faulty control of the urine, than to leave it with an obstructing mass which would cause urinary stasis and continue the suffering from the disease. The manner of proceeding under such circumstances must be left to the individual surgeon.

Occasionally the operator meets with a case in which there is an enormous enlargement of the prostate. The writer has in mind a few cases in which the hyperplastic masses of tissue, while not unduly

adherent, were enormously multiplied in number, forming an irregular mass which almost filled the pelvis, extended beneath the trigone, and obstructed the rectum. One feels that all of this hyperplastic mass must be removed, but in one case operated upon by the writer he believes that by so doing the life of the patient was sacrificed, whereas the removal of the masses occupying more directly the outlet of the bladder might have resulted in the recovery of the patient with an amelioration of his symptoms. So that the surgeon is warned in cases where he feels that the operation is too prolonged and the loss of blood is becoming a serious factor in the patient's condition, that he should be content with removing the portion of the gland causing the obstruction and leaving the other masses for further operation if obstructive symptoms recur.

*The Correction of Defects which are the Result of Prostatectomy.*—Extensive tearing or injury, if it occurs during the course of prostatic enucleation, should be immediately repaired. This refers to a laceration of the rectal wall, the peritoneum, or undue injury to the bladder wall or sphincters. One will never again have so good an opportunity to do so as the time of operation. The closure of fistulae and correction of strictures, if they should occur, are subjects treated in other sections of this work. It may be well to say that in cases where reoperation is to be done through scar tissue, the chances of success, or a near approach to normal condition, is not good.

**Secondary Operation in Cases of Recurrence of Obstructive Symptoms.**—Every urologist of experience will attest the fact that the return of obstructive symptoms after removal of the hyperplastic portion of the prostate is a very rare occurrence provided the operation has been done by a skilled surgeon in a case where the obstruction was due to non-malignant disease of the prostate or the associated glandular groups.

If obstructive symptoms appear soon after, or within two years after the removal of the growth, the surgeon immediately suspects the presence of cancer. Cancer of the prostate occurs sometimes in such forms that its presence is not discovered at the time of the removal of the gland.

There are certain cases in which it is impossible to remove all of the obstructive tissue and still preserve the life of the patient. In such cases we may expect the return of obstructive symptoms, but are often surprised at the completeness of relief that is sometimes secured. When obstructive symptoms do recur, they usually are associated with more pain than with the original lesion, while the amount of stasis may not be so great and the amount of renal destruction may not be so apparent.

To those who have not met with such a condition, the recital of a single case may be instructive.

**ILLUSTRATIVE CASE RECORD.**—The patient was a man sixty-five years of age, who had developed typical symptoms of prostatic obstruction for which he was operated by the suprapubic route by a surgeon who

rarely operated in these cases. The patient recovered well from his operation, but his relief lasted but a short time.

Three years after the original operation he presented himself suffering from painful urination, nocturnal frequency, shooting pains radiating to the rectum and to the meatus, and more or less continual distress in the bladder.

Examination revealed that the urethra was still obstructed. It was impossible to pass any instrument larger than 16 of the French scale. There were also false passages in the urethra. Rectal examination showed that there was some prostatic tissue present in the region of the urethra and of the left seminal vesicle.

The fact that he had lived three years without loss of flesh and strength and without a hard mass being present and palpable per rectum made us feel that the growth was not malignant, but rather a fibrous infiltrated mass of prostatic tissue which had been overlooked in the original operation. It was recommended that the bladder be opened and the tissue cleared out from the neck of the bladder, and the sphincter freed of all prostatic masses. Operation was undertaken.

*Approach to the Bladder.*—Incision was made through the previous scar, carried well up toward the umbilicus, the scar tissue was gradually dissected away until the bladder was reached. Then the peritoneal fold was dissected up, freeing a goodly portion of the anterior surface of the bladder. A laparotomy sponge was placed in the upper angle of the wound, the bladder wall held by stay sutures. The bladder was opened and a rough calculus with characteristics of the urate and oxalate type, one and a quarter inches in length and half an inch in diameter was removed. Then the urethral orifice was sought and found to consist of a sharply defined ring perfectly smooth on the vesical surface with sharp-cut edges causing a constriction, but seemingly not a complete stricture. The bladder wall was quite thin, but not as much trabeculated as would be expected if there had been very much obstruction present.

The question arose in the writer's mind when he saw the thinness of the bladder wall, whether the stone alone were the cause of the symptoms, or whether they were due to the obstruction of the urethra. However, it seemed to him that his duty was to remove the obstruction in the urethra sufficiently to pass a good-sized sound into the bladder.

One prostatic mass was attached to the internal meatus. This was of distinctly fleshy consistency, evidently prostatic tissue. It passed downward under the trigone. It was attached along the border of the sphincter by adhesions and was densely adherent, requiring a very great effort to loosen it. Then a second mass was found nestling along the urethra partly on the left side and partly beneath the urethra on the surface of which was seen scar tissue. This was removed with considerable difficulty. There remained, well off to the side and posteriorly running downward under the trigone, another mass which

seemed to be connected with the seminal vesicle. This also contained nodular masses. It was removed. It was not as densely adherent as the previous specimens had been and did not seem to embarrass the action of the sphincter as much.

This left us with the sphincter entirely free and with the urethral opening clear of obstructions. A sound was passed through the urethra and it was found that there was an obstruction about six inches from the meatus due to cicatricial tissue. This was incised. Then a large button drainage tube was introduced through the urethra to drain the bladder from below and to favor the formation of a new urethra. The bladder was closed with a running chromic gut suture, leaving a small opening at the top for a de Pezzer catheter. The original suture closing the bladder was retained in order to invert the first sutures. The muscles and fascia were brought together with chromic gut suture and the wound closed with silk.

*After-history.*—Recovery of the patient was marred by a slow closure of the suprapubic wound; complete recovery was finally secured. One year later this patient reports that he is in perfect health with no return of his original symptoms.

The case is cited as of importance in encouraging reoperation in cases where the first one has been apparently a failure.

**Causes of Death following Operation.**—Much has been written and many statistics have been compiled, but the ultimate conclusions of most observers are the same, namely, that the most frequent cause of death following operation for prostatic obstruction is primarily renal insufficiency. The second most frequent cause of death is hemorrhage combined with surgical shock. It is safe to say that fully two-thirds of the deaths following operation are caused by one of these two factors. Wade and some of the other observers are inclined to believe that most of the deaths are due to local infection and acute suppurative nephritis. Unquestionably some of the deaths are due to these causes, but certainly few, if any, of those which occur during the first week after prostatectomy are due to acute suppurative nephritis or local infection of the wound. The men who believe this to be the cause of death in most instances acknowledge that the cases upon which they base their judgment have seldom lived more than a week after the operation.

Sepsis undoubtedly plays a part in the mortality records, but its importance has been greatly reduced by an appreciation of the importance of preliminary treatment before prostatectomy is attempted.

Embolism in some form or other is the fourth most important cause of death following operation.<sup>13</sup>

From a study of the reported cases it is evident that the percentage of deaths increase with the age of the patient. Also that the longer the obstruction has existed the greater the percentage of deaths from uremia and hemorrhage.

## BIBLIOGRAPHY.

1. Bugbee: High Frequency Current in Treatment of Tumors of Bladder, etc., *Internat. Abst. of Surgery*, December, 1915, pp. 581-593.
2. Cabot, Hugh, and Crabtree, E. Granville: The Mechanism of the Protection Afforded by the Drainage of Prostatics as a Preliminary to Operation.
3. Hagner: *Surg., Gyn. and Obst.*, xix, 555.
4. Lower: A Technic for Performing Shockless Suprapubic Prostatectomy, *Ann. Surg.*, February, 1914.
5. Lower: Trocar and Cannula for Suprapubic Drainage of Bladder, *Urological and Cutaneous Review*, 1914, No. 1, vol. xviii.
6. Lowsley: The Human Prostate Gland in Youth, *Med. Rec.*, September 4, 1915.
7. Lowsley: *Jour. Am. Med. Assn.*, January 11, 1913, p. 110.
8. Mouillin: Enlargement of the Prostate, p. 135.
9. Pilcher, P. M.: *Ann. Surg.*, April, 1914.
10. Pilcher, P. M.: Transvesical Prostatectomy in Two Stages, *Ann. Surg.*, April, 1914.
11. Squier: Vital Statistics of Prostatectomy, *Surg., Gyn. and Obst.*, p. 433.
12. Tandler and Zuckerkandl: *Folia Urologica, Internationales Archiv für die Krankheiten der Harnorgane*, March, 1911.
13. Tenney and Chase: Mortality after Prostatectomy, *Boston Med. and Surg. Jour.*, clxxii, No. 12, 437.
14. Wade, H.: Prostatism. The Surgical Anatomy and Pathology of the Operative Treatment, *Ann. Surg.*, March, 1914, lix, No. 3, p. 321.
15. Wallace: Prostatic Enlargement, p. 134.
16. Watson and Cunningham: *Diseases and Surgery of the Genito-urinary System*, Vol. 1, Chap. 12. Lea & Febiger, Philadelphia, 1908.
17. Wilson and McGrath: Surgical Pathology of the Prostate, *Surg., Gyn. and Obst.*, December, 1911, pp. 647-681.
18. Young: *Trans. International Assn. of Urology*, 1911, *Jour. Am. Med. Assn.*, January 25, 1913, vol. lx.

## CHAPTER XX.

### CANCER OF THE PROSTATE.

By HUGH HAMPTON YOUNG, M.D.

CANCER of the prostate has until recent years been considered an infrequent disease. The first statistics as to the frequency was apparently an article by Tanchou, who analyzed 8289 cases of cancer in Paris between the years 1830 and 1840 and found only 5 cases diagnosed cancer of the prostate.

Gross, in Philadelphia, was one of the first to furnish definite data in regard to cancer of the prostate about 1850, but it was not until Sir Henry Thompson, in 1861, in his monumental work on the *Diseases of the Prostate*, recognized the importance and predicted the future frequency of the disease.

Thompson published 12 cases, and remarked that cancer of the prostate was probably overlooked frequently, especially in the more chronic forms or indeed where it developed in an already hypertrophied prostate.

Von Recklinghausen contributed greatly to the subject by demonstrating that osseous metastases not infrequently came from cancer of the prostate which was often unrecognized.

The disease was nevertheless considered rare. Socin and Burekhardt, in their splendid book *Krankheiten der Prostata*, in 1902, even held it was seldom met with, until Albarran and Hallé published their "discovery" of 14 cases of carcinoma in 100 supposedly benign prostates, and brought to the attention of the surgical world the considerable frequency of cancer of the prostate. This was followed by papers by Motz, Kaufmann, Hawley, Young, Pousson, Montfort, Hallopeau, Kümmell, Freyer, McGrath, Wildbolz, Verhoogen, Schapiro, and Willms, thus leading to a much greater concentration of interest in and wider diffusion of knowledge of cancer of the prostate.

**Frequency.**—Statistics vary as to the general frequency of cancer of the prostate. In the studies from the records of the Institute of Anatomy in Munich there were 29 cases of cancer of the prostate in 5777 autopsies, or 2 per cent., whereas in Brussels there were only 0.7 per cent. among all, or 1.8 per cent. among males. In the last fifteen years cancer of the prostate has been accorded an increasingly important role and frequency as compared with hypertrophy of the prostate.

As remarked above in 1900, Albarran, in a study of 100 specimens of prostatic hypertrophy in the Musée Guyon, discovered malignant changes—"epithelioma adenoide"—in 14 cases. This caused Geraghty and myself to study our clinical and pathological material thor-

oughly, and whereas we were unable to confirm Albarran's findings, I was able to show a far greater clinical frequency for carcinoma of the prostate than had been recognized previously (21 per cent.).

I made the statement: "In the five years between 1902 and 1907 I have seen 250 cases of benign hypertrophy and 68 cases of carcinoma of the prostate (21 per cent.). I am aware that my figures attribute to cancer a more frequent occurrence than any other in the literature, but I believe they represent the true condition."

Since then there have been numerous confirmatory publications: Oliver Smith's statistics gave a proportion of 16 per cent., Davis 20 per cent., Moullin 25 per cent., Kümmell 20 per cent., Pauchet 20 per cent. At the Institute of Pathology in Munich among 103 deaths from "prostatic accidents" there were found 27 cancers. Wilson and McGrath studying 468 prostatectomy specimens removed at the Mayo Clinic, found that 73 were cancer or 15.5 per cent. Freyer has recorded clinical diagnoses of cancer in 171 cases among 1276 cases of prostatic enlargement or 13.4 per cent. Microscopic examination of his operative specimens has not been carried out in all cases, so the percentage may be higher.

These statistics are sufficient to show that cancer of the prostate is a fairly common disease, and a very important problem in the surgery of the prostate, especially as the importance of early diagnosis and radical excision has been so conclusively demonstrated.

**Etiology.**—The etiology of cancer of the prostate is as obscure as that of cancer in general. It appears at about the same period of life as hypertrophy—after forty years—and most frequently between sixty and seventy years of age.

There is nothing to show that a preceding prostatitis or hypertrophy of the prostate has any causative relation, although both frequently occur with cancer of the prostate. Our studies seem to show conclusively that "malignant degeneration" of hypertrophied lobes does not occur frequently, if at all, and the lesions which Albarran and Hallé described as malignant changes, "epithelioma adenoide," in otherwise benign prostatic enlargements have been seen so often in other conditions—manifestly not malignant—that we cannot consider them to be even forerunners of cancer of the prostate. "Our view has since been confirmed by Tietze, who has met with analogous cellular masses in young prostates, and attributes to them an important role in the development of the gland. Casper, Renge and others have described them in hypertrophy of the prostate. Finally, Brault, Menetrier, and Darier, who have studied them in a case of Pasteau, do not consider them as epitheliomatous but as tangential cuts of normal glandular masses." (Verhoogen.) Our pathological studies (1915) show hypertrophy present with cancer in 61 per cent. of the cases of cancer of the prostate.

Studies made in 1906 seemed to show that prostatic hypertrophy was largely a disease of married men. At that time I remarked that in corroboration of this I had never seen a case of enlarged prostate in a

Catholic priest, although there had been many cases among married Protestant ministers. Since then two priests with enlarged prostates have been encountered, but both were cancer.

**Pathology.**—As remarked above we feel convinced that carcinoma of the prostate does not result as a degeneration of the previously benign adenomatous process; that in about half of the cases it develops where no hypertrophy is present; that in such cases the prostate is often little if at all enlarged; that the carcinomatous growth follows planes of least resistance; that it is very slow in invading fibrous capsules (Fig. 328), both of the prostate itself and also of hypertrophied spheroids, lobules or lobes; that the mucosa and submucosa of both urethra and bladder are also very resistant to it; that the most common site for the begin-



FIG. 328.—Showing the capsule surrounding adenomatous hypertrophy (above) which has resisted extensive adenocarcinoma (below).

ning of cancer is in the posterior subcapsular stratum or lobe, and that from there it may invade the rest of the prostatic glandular tissue or it may travel upward, escaping from the upper end of the prostate in the region about the ejaculatory ducts, and between the fascia of Denonvilliers (Fig. 329) posteriorly, and the trigone anteriorly; that in its further growth the seminal vesicles and vasa deferentia may not become infiltrated, but in some cases their lumina may become filled with cancer cells and, in the case of the vasa deferentia, these may extend upward for a long distance, the outer walls of the vas remaining apparently intact; that the muscle of the trigone and bladder and also the peritoneum may be invaded from this subtrigonal involvement; and, finally, that the fascia of Denonvilliers, which gives the prostate

its most dense capsule posteriorly, is a most effective agent in preventing involvement of the rectum and periprostatic structures.

**Histology.**—Perhaps we can make our description of cancer clearer if we first give our impression of the appearance of the normal prostate and in benign hypertrophy.

The tissue of the normal prostate is rather grayish in color and somewhat moist. It is soft in consistency, but tough. On pressure a small amount of prostatic secretion can frequently be squeezed out. The cut surface is apparently smooth and homogeneous, but on close inspection the tiny glandular orifices can be discovered. Sometimes the orifices of dilated acini are very evident.

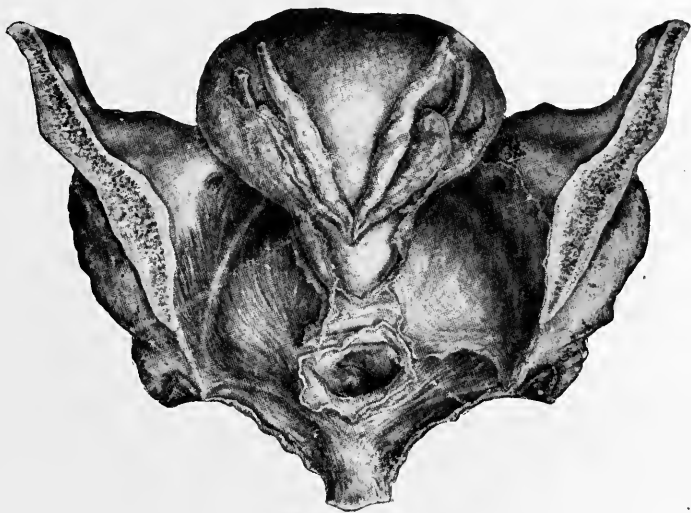


FIG. 329.—The aponeurosis of Denonvillier's which covers the posterior surface of prostate, seminal vesicles, vasa deferentia; here partly removed to show these structures. (After Deaver.)

The tissue of benign prostatic adenoma is usually quite characteristic. It has a lobular appearance due to the formation of varying sized spheroidal tumors often definitely encapsulated, the lobular mass as a whole being compressed by a more or less well-developed capsule formed from the condensed peripheral prostatic tissue. The tissue is usually elastic or soft in consistence, and on section is moist. Frequently large quantities of a milky fluid ooze from the prostatic acini. Many of the lobules have a moth-eaten appearance due to the presence of dilated acini. In other lobules where the glandular elements are not so numerous, and the stroma predominates, the surface is rather smooth and slimy.

Practically no difficulty is encountered in differentiating carcinomatous prostatic tissue from the tissue of hypertrophy or of the normal prostate, presupposing of course that the carcinomatous area is of sufficient size to be discernible. The greatest difficulty arises from the

tissue of a long-standing fibroid prostatitis. Carcinoma is usually quite characteristic. It is hard, dense, and on pressure gives very little sense of elasticity (which is generally still present even in well-advanced fibroid prostatitis). On cutting into the carcinoma it imparts a gritty sensation to the knife blade. No secretion oozes from the cut surface, which is rather homogeneous, lacking the lobulation so characteristic of hypertrophy. Occasionally where the cancer has invaded a previously benign adenoma an indefinite lobulation may persist in this tissue, but it is seldom confusing.

The finer details of the cut surface vary. Sometimes irregularly interlacing translucent bands of varying size are seen with small grayish-yellow islands scattered here and there, the translucent bands being fibrous in character, and the yellowish areas accumulations of cancer cells. This appearance is not present in fibroid prostatitis, in which the epithelial elements practically disappear, and the surface is much more smooth and homogeneous than in cancer. Where the cancer is infiltrating in character, fine alternating translucent and yellowish lines can frequently be seen by the aid of a small magnifying lens. Usually one can be moderately certain of the cancerous nature of the tissue from gross inspection alone. When the operator's knife, in making the capsular incisions, cuts through dense tissue which does not bulge, the edges of which are firm and rigid, suspicion should be at once aroused.

If after passing through such a layer of hard tissue a bulging hypertrophied lobe is encountered, the diagnosis of coëxistent cancer and hypertrophy is generally justified. The capsule of the average hypertrophy is rarely thick, nor is it so dense and gritty as that of cancer.

*Microscopic.*—The histological character of cancer of the prostate is very variable, being greatly modified by the character of tissue invaded and age of cancer and the method of extension.

A classification according to type of cell is, as a rule, impossible, as no one type is preserved throughout, the same section often showing great varieties of shapes and sizes. In our 2 cases in which cancer areas a few millimeters in diameter were discovered in the specimens removed at operation the microscope showed a definite adenocarcinoma, but in one of these, even at this early stage, marked infiltration into the stroma had begun.

In 10 apparently primary cases the cancer more often tended toward the scirrhus type, 7 being of this type (Fig. 330). In 3 cases no glandular formation was present; in the other 4 cases occasional small groups of atypical acini were seen, but the great bulk of the tissue was scirrhus. At times the fibrous overgrowth is so marked that epithelial elements may be almost wanting, or the fibrous stroma is so dense that the cancer cells are often not recognizable, small nuclear specks being alone visible. This may lead to error of diagnosis if only a small section is examined. At other times definite masses or infiltrating lines of irregular-shaped cancer cells are seen, the size and shape seeming to depend largely upon the compressing force of the fibrous stroma.

Those of the adenocarcinomatous type present most varying pictures.

At times acini, formed of irregular cells, often with big, deep-staining nuclei, are scattered at wide intervals, the intervening tissue being more or less densely infiltrated with cancer cells. At other times the cancer acini are so numerous and close together that the fibrous stroma may be difficult to see. The acini in these areas are usually very small and lined by small cylindrical cells, often quite irregular in shape and with small rounded nuclei. Often over large areas no attempt at a glandular reproduction occurs, cancer cells simply growing aimlessly through a fibrous stroma (Fig. 331). Occasionally normal acini are found persisting in large areas of cancer.

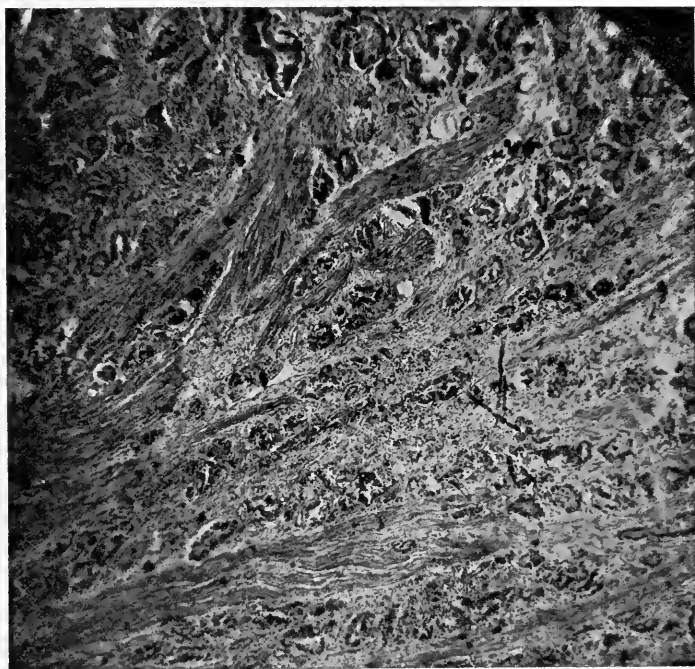


FIG. 330.—Scirrhus form of adenocarcinoma.

Cancer of the prostate spreads in two ways, by direct extension through the stroma and by extension along the ducts. As a result of this duct extension one sometimes sees masses of cancer cells filling the acini, the intervening tissue being entirely normal.

**Cancer Associated with Hypertrophy.**—In our cases in which cancer and hypertrophy were present together (48 in 71 cancer cases, or 61 per cent.) the cancer, as remarked before, generally forms a layer beneath the posterior capsule, and the hypertrophied lateral lobes lie in front of and distinctly separated from cancer by their own capsules which are generally intact (Fig. 332). When the cancer breaks into a hypertrophied adenomatous lobule it spreads rapidly along the ducts, thus

giving an extremely puzzling picture (Fig. 333) of glandular acini lined or filled with cells different in type from the cells of the ducts or acini of an

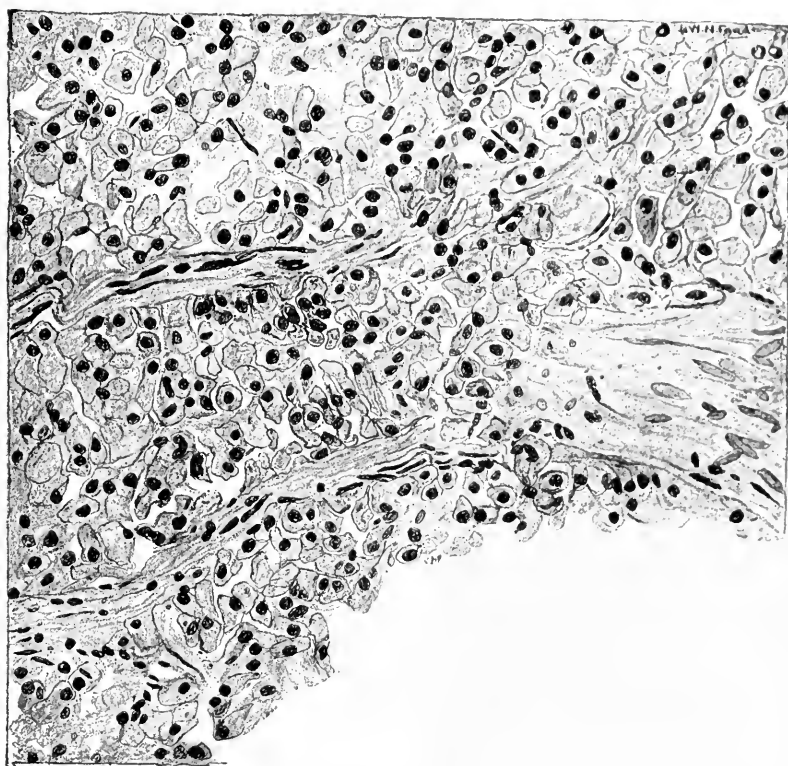


FIG. 331.—A medullary form of carcinoma in which there is very little stroma and the cancer cells varying in size and shape are loosely arranged.

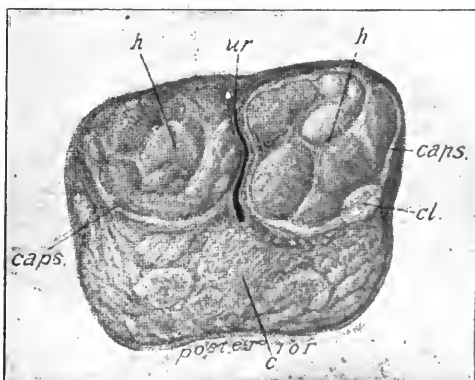


FIG. 332.—Transverse section in front of verumontanum, showing two large hypertrophied lobes on each side of the urethra and thick posterior subcapsular area of carcinoma. Capsule of right lateral lobe invaded in one place (*cl*).

adenomatous hypertrophy, but with a basement membrane often intact and a normal intervening stroma. Frequently a single layer of cells will relined a duct or acinus so that except for the character of the cell the acinus looks entirely benign. However, we have never seen these broad cylindrical cells with clear, pale-staining protoplasm and nuclei centrally placed either in the normal or the hypertrophied prostate. In other acini the cells are heaped up at different points along the gland



FIG. 333.—Showing spread of the carcinoma by way of the ducts. Solid strands of epithelial cells are seen growing into the lumina of the tubules and by their union forming irregular open spaces. There is no infiltration of the stroma.

wall, and grow across the lumina sometimes in solid masses, but more frequently as interlacing strands (Fig. 333). Sometimes the cancer cells arrange themselves circularly, leaving a central lumen as if in an attempt to reproduce a gland structure. When the lumen is completely filled the cells crowd each other into most odd and peculiar shapes.

These areas of duct carcinoma are not apt to be mistaken for benign tissue if the character of the cells is noted. Particularly characteristic

is the tendency of cancer cells to grow in strands across the lumen of the acinus without any supporting connective-tissue framework. This does not occur in hypertrophy. In the latter when an epithelial budding from the wall of the acinus occurs, it is quickly followed by a supporting stem of connective tissue. It has been said that the acini of the normal or hypertrophied prostate when filled with desquamated epithelial cells may be difficult to differentiate from cancer of the duct type. With exercise of ordinary care no confusion from this source should occur. Later, with the advance of the main growth through the stroma or the breaking through from the acini, the picture is changed. The tubules of cancer cells with a more or less densely infiltrated stroma are seen, sometimes the intervening tissue is scirrhous, sometimes of an adenomatous type, and sometimes the cancer cells are so closely packed that a fibrous stroma seems almost entirely absent and a medullary form of cancer is produced. Sometimes portions of the cancer seem more or less definitely alveolar. When the cancer invades hypertrophied lobes of the adenocystic type, in which the interacinar stroma is frequently small in amount, the picture presented is that of cancer cells packed in the dilated spaces, resulting in an alveolar form of carcinoma medullary in character (Fig. 331). In none of our specimens, either primary or those associated with hypertrophy, was a pure adenocarcinomatous type preserved throughout. Areas of adenocarcinoma were present, however, in great or less degree, in practically every case except in the three cases of pure scirrhous previously mentioned, in which the cancer occurred in a prostate not previously hypertrophied.

Very rarely have we found evidence of gross or microscopic necrosis, no matter how extensive the disease. The extensions of the disease to the seminal vesicles and bladder are usually infiltrating in character, although frequently the adenomatous form is here and there discovered. For one familiar with the histological character of the normal and hypertrophied prostate, the microscopic diagnosis of cancer seldom entails any difficulty, except in the scirrhous, where, occasionally, over small areas, the fibrous overgrowth may be so intense that no definite epithelial elements are recognizable, small scattered nuclear specks alone being visible. However, this fibrous density is of itself suspicious, and a section from a different area will usually at once settle this doubt.

**Symptoms.**—From a surgical stand-point the early symptoms in carcinoma of the prostate are the important ones, and unfortunately a survey of the literature is of little help in this respect. At the onset it is necessary to distinguish between early and late cases.

In a study of 12 *early cases* I found it necessary to make three subdivisions.

1. Those in which the only pathological process present is cancer, 6 cases.

2. Those in which cancer is associated with hypertrophy, 5 cases.

3. A case of chronic prostatitis with a small area of cancer in it.



Regular catheterization was necessary in Case V for one year, in Case II for ten months, and in Case IV for four months. In Case I suprapubic drainage became necessary three years after onset.

Class 3. The case in which chronic prostatitis was present along with a nodule of cancer was a man, aged sixty-one years, who had for fifteen years had symptoms of irritation in the deep urethra and attacks of frequency of urination. Catheterization was never necessary and hematuria and pain were never present.

In conclusion it seems from a study of the above early cases (and other later cases) that the symptomatology of cancer of the prostate in the early stages is almost identical with that of benign hypertrophy, so that we must look entirely to a careful physical examination to furnish suspicion of cancer.

*The Examination.*—There was nothing in the appearance of any of these twelve patients to suggest malignant disease; they were not emaciated nor were they suffering pain, with the exception of 4 cases, and in these it was not severe. The urine was free from blood in all cases.

In the 6 cases not associated with hypertrophy the size of the prostate was described as considerably enlarged in 3 cases, moderately enlarged in 2 cases, and slightly enlarged in 1 case. The surface was smooth in 2 cases, rough in 3 cases, nodular in 3 cases. Here we have in 6 cases conditions which should always make one suspicious of cancer; for the benign adenomatous prostates, unless associated with considerable inflammation or with calculi of the prostate, are nearly always smooth, though they may be lobulated. The consistence was described as very hard in all of the 6 cases not associated with hypertrophy, and in some was said to be "stony hard." In 5 cases both lobes were involved, but in 1 case the left half of the prostate was normal. In this interesting case (in which an urgency of urination had been present one year) the right lobe was enlarged, very hard and rough, the induration extending to the median line, where it ended abruptly, forming a straight edge well elevated above the normal left half of the prostate. The lower portion of the right seminal vesicle was involved, as was the posterior part of the membranous urethra. The contrast between the two halves of the prostate here was most sharply defined. In 1 case there was a hard nodule in each lobe, which was otherwise soft on each side. Two years later the whole prostate was rough, irregular, very hard, and greatly enlarged. In the other 4 cases, although in 2 symptoms had been present only one year, the prostate was completely invaded by cancer on both sides, although the vesicles were mostly free.

In a recent case, not tabulated above, the first examination three years ago showed a nodule 1 cm. in diameter in the left lobe. At the next examination two years later it was 2 cm. in diameter, and one year later all of the left lobe was involved, but it was still within the prostatic capsule. This case shows the remarkably slow growth in some cases.

The 5 cases associated with hypertrophy are interesting: In Case I (J. T. Y., No. 463) the prostate was considerably enlarged, smooth,

rather hard in consistence. Microscopic study showed benign hypertrophy associated with prostatitis on both sides, with only one small area of cancer in prostatic tissue which was the seat of prostatitis.

In Case II (T. C. S., No. 2750), in which symptoms had been present only six months, the left lobe was only slightly enlarged, smooth, and elastic. On the surface of the right lobe there was a prominent lobe 1 cm. in size, which was quite hard, but seemed elastic on pressure. (This proved, however, to be entirely cancerous.) The right lobe was otherwise very little enlarged, and the seminal vesicles were not indurated, but nevertheless cancer was present in the lower portion of the left seminal vesicle. The left lobe when removed was found to be a benign hypertrophy, the right being cancerous.

In Case III (W. J. R., No. 1779) the prostate was moderately enlarged and generally indurated (but not stony), with three very hard nodules present, one in the median line near the apex, one at the upper end of the left lateral lobe, and one near the apex of the right lateral lobe. Seminal vesicles negative. At operation a layer of cancer beneath the posterior capsule was found on the left side, beneath which was a benign hypertrophied lobe, on the right side and also in the median portion, benign hypertrophied lobes were removed.

In Case IV (J. R., admitted June 26, 1905) the prostate was moderately enlarged, smooth, the right lobe was elastic and only slightly indurated. Operation showed a posterior layer of cancer with a hypertrophied lobe beneath. The left lobe was smaller and softer, and proved to be benign hypertrophy.

In Case V (E. G. W., No. 206) the prostate was considerably enlarged, smooth, but very hard. Examination showed a posterior subcapsular layer of cancer, with benign hypertrophy in front of it on both sides.

A review of these 5 cases shows that the presence of hypertrophy of the lateral lobes generally gives an elasticity to the prostate on deep pressure which is very deceptive. In these cases a small layer or nodule of cancer lying between the capsule and an hypertrophied lobe may be compressible on deep pressure. More delicate palpation, and particularly palpation upon a cystoscope in the urethra, will often show the real induration of the local carcinomatous area.

These localized areas of induration or nodulation should always be suspected and subjected to early perineal operation.

The case characterized by a small nodule of cancer in a prostate which was the seat of a chronic prostatitis of fifteen years' standing showed on rectal examination a prostate smooth, slightly indurated and not tender. The small nodule was not detected, and was only found accidentally when the stained sections of the tissue removed were examined.

The clinical examination of the seminal vesicles in these 12 early cases shows no definite invasion of these structures. In 1 case only was there an induration for a short distance in the region of one vesicle, but subsequent pathological examination (after radical operation) showed that the carcinoma had not penetrated the seminal vesicles as

supposed but lay between it and the excised trigone, an area of cancer 1 cm. long being present. In the 2 other cases in which the radical operation was carried out only the juxta-prostatic ends of the seminal vesicles and vasa deferentia were invaded.

The vesical mucosa was normal in all of these cases, and no invasion of the trigone was present, as shown by the cystoscope and at operation.

The 6 cases in which no coexistent hypertrophy of the prostate was present showed, on cystoscopic examination, only a small median bar with no intravesical enlargement of the lateral lobes. In 1 case the median portion formed a small sessile lobe, and 1 case showed both a median bar and a slight right lateral enlargement.

The characteristic picture, then, in early cancer of the prostate is a small bar, unaccompanied by marked lateral intravesical enlargement.

In 1 case a carcinomatous constriction of the prostatic urethra was present, requiring dilatation before cystoscopy was possible, but there was no evidence of ulceration of the urethra in any case.

In later cases stricture of the prostatic urethra is not an uncommon finding, and is to be considered very suggestive of cancer.

**Diagnosis.**—The diagnosis of early carcinoma of the prostate is principally based on the finding of great induration in a portion of the prostate, as shown by our cases. It may occur as one or more small nodules or lobules which may be prominent or imbedded in the prostatic tissue, but apparently always palpable per rectum. In later cases one whole lobe, or both lobes, may be involved, but the disease apparently remains well encapsulated for a fairly long period, and the line of progress is upward, beneath the fascia of Denonvilliers (which forms the posterior capsule of the prostate and seminal vesicles (Fig. 329), the ejaculatory ducts and the structures between the lower ends of the vasa deferentia and the bladder being invaded after the cancer cells pass beyond the limits of the prostate. Induration immediately above the prostate and easily palpable, with a finger in the rectum and a cystoscope in the urethra, as a hard subtrigonal thickening, is of great diagnostic value. In later cases this "interventricular plateau" of induration becomes more and more pronounced, but it is remarkable how long the upper portions of the seminal vesicles and vesical mucosa are free from invasion.

In a series of 111 cases, many of them late and over 50 per cent. associated with prostatic hypertrophy which necessarily modifies the symptoms and the progress of the disease, there were 76 in which the first symptom was frequency of urination, and in 48 cases difficulty of urination was also present. In 4 cases the onset was ushered in with hematuria, and in 4 with complete retention of urine.

Pain was not infrequently an initial symptom, and its location in these cases has been tabulated as follows:

	Cases.
Urinary tract (bladder or urethra) . . . . .	16
Rectoperineal region . . . . .	7
Inguinal and scrotal regions . . . . .	2
Dorsal, sacral or gluteal regions . . . . .	6
Lower extremities . . . . .	3
Hypogastrium . . . . .	1

In most of the cases in the above tabulation the pain was generally quite marked and sometimes very severe. Those cases in which only very slight burning was complained of were not included, though several cases in which the burning was severe and amounted to a pain have been included. There was one patient in which irritability in the bladder was quite marked. One patient, aged sixty-four years, was suddenly seized, during urination, with an excruciating pain which radiated from the bladder to the end of the penis, and after that recurred frequently. In another case the onset symptom was pain in one groin and down the back of the thigh, which his physician told him was rheumatic in character, and gave him "appropriate" treatment for seven months, when, for the first time, a very slight difficulty of urination was noticed. Only four weeks before admission were his urinary symptoms sufficient to call attention to his prostate, by which time the entire prostate and seminal vesicles were involved in an extensive carcinomatous growth. In another case the first symptom, which came on suddenly two and a half years before admission, was a severe pain in the rectum which became continuous and grew steadily worse. Another patient had had only one symptom since the beginning, three months before, sharp, shooting pains in the left hip radiating down the left thigh to the knee and associated with numbness which extended to the foot. There was practically no urinary disturbance, although the membranous urethra, prostate, seminal vesicles, pelvic glands, and rectum were involved in an extensive carcinomatous mass.

In 145 cases of benign hypertrophy the onset symptoms were as follows:

	Cases.
Frequency of urination . . . . .	88
Difficulty of urination . . . . .	78
Pain . . . . .	25
Hematuria . . . . .	7
Complete retention of urine . . . . .	8
Incontinence of urine . . . . .	8

In 12 of the 25 cases of benign hypertrophy in which pain was present there was only a slight burning in the urethra, and in 3 the pain was merely the discomfort produced by straining to void. In 1 case there was sharp pain which followed sudden stoppage of urine during micturition. In 9 cases calculi were present. In no case were there the symptoms of sciatica or severe pain in the hips, buttocks, thighs, or groins which have been seen in many of our cases of carcinoma.

Hematuria is shown to have been a more common initial symptom in benign hypertrophy than in carcinoma.

In conclusion it may be remarked that in the majority of cases the onset is much the same as that of benign hypertrophy; an increase in the frequency and difficulty of urination, which is often slowly progressive in character. Pain alone is a much more common symptom, and frequently remains for a long time the only symptom. In one remarkable case the first and only symptom complained of was pain in the legs.

In 60 cases which were studied by Motz the initial symptom was: difficulty of urination in 38 cases; complete retention of urine in 8 cases; hematuria in 8 cases; neuralgia in 5 cases.

**Duration and Course of Disease.**—Guyon recognized three forms: (1) those with a rapid course, in which the symptoms may have been present a very short time; (2) those following a subacute course, the disease having been present after the tenth or twelfth month; and (3) those following a very slow course with a duration of two or three and even as long as nine years. In 26 carefully studied cases Motz found that 40 per cent. of the patients died within seven months after the initial symptoms, 7 lived over a year, and 6 for periods varying from two to ten years. In making this study we have prepared a table which shows the duration of various symptoms in our cases.

DURATION OF VARIOUS SYMPTOMS AT TIME OF ADMISSION OF PATIENT.

	Difficulty of urination.	Frequency of urination.	Pain in urinary tract.	Pain in rectum and perineum.	Pain in groin and testicle.	Pain in lower extremities.	Pain in back.	Pain in supra-pubic region.
1 to 6 months . . . . .	10	9	13	4	..	13	9	4
6 to 11 " . . . . .	4	5	4	1	1	..	12	..
12 to 17 " . . . . .	14	12	4	2	3	3	3	2
18 to 23 " . . . . .	3	3	1	..	..	1	2	..
24 to 36 " . . . . .	18	22	2	1	1	2	1	2
Over 3 years . . . . .	..	..	..	..	..	..	1	..
3 to 5 " . . . . .	4	9	..	2	..	..	..	..
6 to 10 " . . . . .	6	7	2	1	..	..	1	..
Over 10 " . . . . .	2	1	2	..	..	..	1	..

As shown in the above tabulation symptoms were present in many cases for prolonged periods, the longest being twenty years, during which the patient had difficulty of urination and more or less frequent catheterization. There were 5 cases in which symptoms had been present more than ten years. None of these cases, however, were subjected to prostatectomy, and we cannot therefore say with positiveness that the early symptoms were not due to benign obstruction to urination. In 23 operated cases in which there was no hypertrophy, the entire prostate being carcinomatous, there was one in which difficulty and frequency of urination had been present for six years and severe pain for five years, and other cases in which frequency and difficulty had been present for three years in 1 case, two years in 2 cases, one year in 3 cases, and six months in 1 case. These statistics are sufficient to show that the course of the disease is very variable in its duration, some cases being extremely rapid and ending in death in less than a year; but in the majority is of two or three years' duration, many cases extending over three or four years, and a few cases over five years.

In the above tabulation it is noteworthy that pain came on much

later than urinary obstruction. In only 13 cases of the 111 had pain been present over three years and in the majority of cases under eighteen months.

**Catheter Life.**—In 21 cases the patient had complete retention of urine and had used a catheter regularly for varying periods up to three years. In 13 cases the catheter had been used less than six months, in 5 cases over a year, and in 2 cases over two years. In 23 cases, although the patient was able to void, urination was so slow, difficult, and frequent that the catheter was used one or more times daily. In 14 of these cases this has been present for less than six months, in 3 cases between six months and a year, in 2 cases over one year, in 3 cases over two years, and in 1 case five years. In 8 cases complete retention of urine occurred occasionally, requiring catheterization, but these patients did not use the catheter every day.

*When the patient was admitted to the hospital the symptoms presented were as follows:* Complete retention of urine and catheter life 19 cases. The number of times daily in which catheterization was necessary was as follows: Two times, 2 cases; three times, 4 cases; four times, 2 cases; five times, 1 case; six times, 4 cases; eight times, 3 cases; ten times, 2 cases; twenty times, 1 case.

Incomplete retention of urine but catheter used, 22 cases; once daily, 2 cases; twice daily, 5 cases; three times, 4 cases; four times, 5 cases; five times, 3 cases; six times, 1 case; seven times, 1 case; every few minutes, 1 case.

In those cases in which urination was possible the difficulty of urination was great in 28 cases; moderately difficult in 6 cases, slightly difficult in 5 cases.

The frequency of urination was very frequent (every few minutes to one hour) in 38 cases; moderately frequent (about every two hours) in 7 cases; slightly more frequent than normal in 13 cases. In 2 cases there was constant dribbling of urine associated with a large amount of residual urine.

**Pain.**—The location and the severity of the pain present on admission is graphically shown in the accompanying table:

	Slight.	Moderate.	Severe.
Urethra . . . . .	4	4	10
Penis . . . . .	3	4	11
Perineum . . . . .	3	5	7
Bladder . . . . .	4	2	9
Rectum . . . . .	2	0	10
Groin . . . . .	1	1	0
Testicle . . . . .	3	0	3
Hip . . . . .	2	3	4
Thigh . . . . .	2	4	8
Leg . . . . .	2	8	8
Foot . . . . .	1	1	3
Lumbar . . . . .	5	3	7
Sacral . . . . .	2	2	5
Buttocks . . . . .	0	4	1
Pubic . . . . .	2	3	5
Renal colic . . . . .	0	0	0

The regional pains above tabulated most frequently occurred in groups. Of these the genito-urinary was the most common, and was characterized by pain in the bladder, urethra and penis, especially during urination. The rectum and perineum were also grouped together, the pain there being generally due to pressure from the enlargement of the gland, which was often sufficient to greatly reduce the lumen of the rectum and render defecation difficult. The other groups of symptoms may be classed as referred rather than local. Among them were noticed three distinct groups: Those radiating to the groin and testicle, those radiating to the lower extremities, and those radiating to the back, sides, and buttocks. The explanation of these pains is probably the same as in cases of chronic prostatitis, a reference of painful stimuli to other nerves running into the same segment of the cord as the periprostatic nerves.

**Hematuria.**—Hematuria was present at one time or another during the course of the disease in 16 cases. In 10 of these it had been intermittent and only once considerable in amount. In 3 cases the amount of blood present was moderate and in 6 slight. In 6 cases blood was continuously present, in 1 slight, in 2 moderate, and in 3 considerable in amount. Examination of the urine on admission showed blood in 8 cases, and in 6 of these it was very slight in amount, but in 3 cases it was quite considerable.

Hematuria seems to be more suggestive of vesical tumor, calculus, or a benign middle lobe. It is certainly not so commonly present as in cases of benign hypertrophy of the prostate, as in my series of 145 cases I found it present in 15 per cent. The absence of hematuria is due to the fact that carcinoma of the prostate does not invade the bladder except in a small proportion of cases, but is retrovesical and pelvic rather than intravesical. It is also interesting to note that there are no cases in this series in which hemorrhage from the penis occurred, although in 3 cases the anterior urethra was surrounded with more or less extensive carcinomatous infiltration, in 1 case producing a continuous carcinomatous priapism.

**Loss of Weight.**—In 30 cases considerable, in 11 cases moderate, in 7 cases slight, and in 13 cases no loss of weight was recorded. In 28 cases no mention was made on this point. Although in the later stages of the disease the emaciation was profound and rapid, I have seen a great many cases with very extensive and long-standing carcinoma which were not associated with any loss of weight, and the patient remained markedly active and strong.

The following table shows the condition of the sexual powers in 47 cases present on admission as given by patients in cases in which a record had been made:

SEXUAL POWERS.

Erections.	Coitus normal.	Coitus impaired.	Coitus not attempted.	Coitus impossible.
Normal . . . . .	8	..	2	
Diminished . . . . .	1	4	3	1
Absent . . . . .	..	..	4	24

While it is true that carcinoma has a much more decided effect upon the sexual powers than hypertrophy of the prostate, as shown by the above table, it is also true that in cases of extensive involvement of the prostate and seminal vesicles there may be no impairment of the sexual powers. One patient, upon whom a radical operation was performed, stated on admission that erections were normal, coitus normal and indulged in about three times a week, and that ejaculation, though not quite so free as formerly, was not accompanied by pain. In this case the entire prostate was carcinomatous and both seminal vesicles and vasa deferentia were filled with carcinomatous cells. In another case in which symptoms of urinary obstruction had been present for four years, in which the seminal vesicles and prostate were extensively involved and the radical operation was performed, microscopic examination showed both vasa deferentia and seminal vesicles completely filled with carcinoma cells, the patient reported that intercourse was entirely satisfactory. In some cases the only complaint is that the amount of semen ejaculated was less than normal.

**Duration.**—As shown in the statistics given above, cancer of the prostate (even when unaccompanied by hypertrophy) may be of slow growth and remain for a long period well confined within the capsule of the prostate. Several years may undoubtedly elapse before periprostatic structures, seminal vesicles, and trigone are much invaded, so that the chances for radical excision are often excellent.

**Physical Signs.**—We have already recorded our findings in the early cases. Briefly stated, induration is the most important diagnostic sign and should lead to suspicion if only a small area of the prostate is involved. This induration is generally very marked and often almost stony. In our earliest cases the area was so minute that it was not recognized clinically, but in all these cases the region involved was near the posterior capsule. In a few instances a smooth, rounded, very hard area in an otherwise soft prostate was present and proved to be carcinoma, and in other cases one-half was indurated and sharply demarcated from the rest of the prostate. As a rule, however, the whole posterior surface presented a very hard surface which was often smooth and well defined laterally. In many cases there was a slight roughness, and in a few early and most late ones a markedly nodular condition.

This diagnostic induration is generally harder than in prostatitis or tuberculosis of the prostate, and the suburethral portion is more uniformly involved. In some cases, especially where prostatitis has also been present, diagnosis is very difficult, and an exploratory perineal operation, at which sections of the subcapsular indurated areas may be necessary before diagnosis can be made, should be done.

The progress of the cancerous invasion is usually into the tissues between the seminal vesicles and the bladder and characterized by an induration which is usually more marked than in seminal vesiculitis. Sometimes the seminal vesicles are not in themselves invaded and can be palpated as soft distended sacs behind the indurated area beneath the trigone.

A transverse plateau of induration above and continuous with the prostate, and involving the region of both seminal vesicles, the inter-vesicular, and subtrigonal tissues, is often encountered. If this has not progressed too far above the prostate the case may still be radically operable. But usually it is much too far advanced.

Enlarged glands which are rarely found except late are of little diagnostic value—when present the malignant nature is evidenced by the character of the prostate itself and the glands are usually so far out along the pelvic wall that hope of radical cure is gone.

In a series of 111 cases enlarged glands were found by rectal examination adjacent to the prostate in 3, near the seminal vesicles in 4, along the lateral wall of the pelvis in 13, and in the sacral fossa in 6 cases. In 22 cases enlarged glands of the groin were found and in 2 cases in the iliac fossa.

When we consider the very extensive enlargement of the prostate and seminal vesicles which was present in these cases it seems remarkable that the lymph glands were so seldom involved, but our findings correspond to those of Kaufmann, who discovered in 100 autopsies upon patients dying of carcinoma of the prostate only 27 cases in which there was involvement of the pelvic lymph glands. It shows the fact that one should not expect enlarged glands before making a diagnosis of carcinoma of the prostate.

**Rectal Examination.**—The condition of the prostate, etc., at examination, is shown thus:

	Prostate.	Both.	Seminal vesicles. Right.	Left.	Intervesci- ular space.	Membran- ous urethra.
Size:						
Slight enlargement . . . . .	16	8	3	2	10	2
Moderate . . . . .	27	19	3	3	15	8
Considerable . . . . .	64	39	2	3	37	24
Indefinitely described . . . . .	4	..	..	..	..	..
Surface:						
Smooth . . . . .	32	7	1	1	5	..
Rough . . . . .	69	30	3	3	25	6
Not noted . . . . .	10	..	..	..	..	..
Consistency:						
Soft . . . . .	2	..	..	..	..	..
Elastic . . . . .	1	14	3	5	7	11
Slightly indurated . . . . .	..	2	2	1	3	..
Moderately indurated . . . . .	6	3	7	4	2	24
Very hard . . . . .	78	56	2	2	49	26
Stony . . . . .	9	9	..	..	10	5
Mixed, soft and hard . . . . .	10	..	..	..	..	..

**Consistence.**—In the above tabulation of the prostatic findings the one thing that stands out prominently is the induration. Whereas the large majority of benign prostatic hypertrophies are elastic or even soft, there is only 1 case of cancer which was described as elastic, and none were entirely soft (barring 2 cases spoken of below).

In our series of 145 cases of benign hypertrophy the prostate was described as soft in 56, firm in 45, moderately hard in 14, very hard in none, stony in none. The marked contrast is at once apparent, and it is only necessary, therefore, to say that whenever the prostate or only a portion of it is quite hard it should be viewed with suspicion.

The case in which the prostate was everywhere elastic was one in which the lateral and median lobes were considerably enlarged by benign hypertrophy and the carcinoma was confined to a small area (about 1 cm. in diameter) in the anterior commissure, which could not be palpated by rectum. In 2 cases the seminal vesicles were very hard and evidently markedly involved by cancer, but in the region of the prostate there was a very prominent, smooth, soft, almost fluctuating mass, oval in shape, and evidently hematoma or blood cyst beneath the posterior capsule. In neither of these cases was operation performed; but in another case in which a perineal prostatectomy was done a cyst 1 x 1.5 cm. in size, filled with brownish fluid, was found just beneath the capsule next to the cancer, and was, I believe, the same process (old hematoma) but of a smaller size.

It is the group of 10 cases described above as mixed, soft, and hard that are the most interesting, as it contains many in which the diagnosis was extremely difficult, and often not made except on the operating table and with the aid of stained frozen sections. In all but 2 of these 10 cases perineal operations were performed (radical 2, conservative 6), and the tissues have been carefully examined. In 6 of these benign hypertrophy was present along with cancer. In 2 of these one lobe of the prostate was soft and showed only a benign hypertrophy, but on the other side, which was hard, there was a layer of carcinoma between the capsule and the hypertrophied lateral lobe. In 3 cases the subcapsular "shell" of carcinoma was present also on the soft side, but was thin enough to transmit the elasticity of the hypertrophied lobe beneath.

In 1 case only one nodule of cancer (about 1 cm. in diameter) was found beneath the capsule on the left side. The rest of the prostate was composed of benign adenomatous spheroids.

In 2 cases in which the radical operation was done no benign adenomatous hypertrophy was present, the entire prostate being replaced by cancer. In both of these cases it is difficult to explain the comparative softness of one of the lobes which was noted on several careful examinations.

A review of these 10 cases seems to show that the coexistence of benign adenomatous hypertrophy may lead to a modification of the induration usually found in cancer of the prostate when the layer of the cancer between the posterior capsule and hypertrophied area is not too thick to transmit the elasticity of the hypertrophied lobe beneath. When no hypertrophy is present the prostate is almost always very hard in those portions of the prostate involved by cancer.

The *induration* usually found in carcinoma of the prostate is of a peculiar incompressible character, entirely different from that seen in tuberculosis and chronic prostatitis, and, as shown above, usually not associated with any areas of softness unless a portion of the prostate be still uninvaded or unless there be an elastic hypertrophied lobe beyond a thin shell of carcinoma. When the entire prostate has become involved the diagnosis is at once apparent. The prostate is usually more firmly fixed in its location by pericapsular adhesions (due to inflammatory infiltration as is often seen adjacent to carcinoma and not

necessarily cancerous invasion). Where only a portion of the prostate is involved, and especially when coexistent with hypertrophied lobules, the diagnosis is often very difficult, and in fact impossible; but the presence of such an area of induration should lead to a suspicion of carcinoma, and careful investigation at operation with incision of the suspected area (if necessary) and perhaps stained frozen sections. In such cases the consent of the patient to a radical operation, in case the disease should prove carcinomatous, should be obtained beforehand. As noted above the enlargement was slight in 16, moderate in 27, and considerable in 64 cases. As a rule, when the carcinoma has not spread beyond the prostate there is only a moderate amount of enlargement present, and often the prostate is only very slightly enlarged. In most of our early cases this was the condition present, and not infrequently, owing to the small size, their physicians were apt to consider the prostate negative on rectal examination even when the disease had spread to the space between the seminal vesicles and bladder. The line of demarcation between the prostate and the extensive transverse plateau of induration above it is often impossible to outline, and not infrequently the prostate is described as considerably larger than normal, and at operation the enucleated lateral lobes are found to be very little enlarged.

The *surface* of the prostate, as indicated above, was smooth in 32 and rough in 69 cases. Under the head of rough we have included cases described as irregular, with a nodule here and there, as well as those in which marked roughness was everywhere present. One of the most surprising findings has been that the surface is remarkably smooth in many cases. This is due to the fact that the fascia of Denonvilliers, which extends from the triangular ligament upward beyond the seminal vesicles as a tense fascia closely applied to the posterior surface of the prostate in the anterior of its two layers, makes a firm barrier against invasion toward the rectum. In fact, this fascia remains itself free from invasion generally until late in the disease, but although many of the cases are perfectly smooth, when roughness is present, it is usually so entirely different from anything seen in hypertrophy of the prostate that carcinoma should at once be suspected.

In our series of 145 cases of *benign hypertrophy* there was only 1 case which was rough and nodular, and in 14 cases in which the smoothness of the posterior surface was distorted by the presence of one or more lobules which projected beyond the confines of the rest of the hypertrophied prostate, in some cases having broken through the posterior capsule, generally at the upper end on one or both sides, and thus projecting into the region of the seminal vesicles, and occasionally toward the apex of the prostate, where the lobule sometimes encroached upon the rectum. In these cases, however, the lobule was smooth and generally somewhat elastic, and entirely different in its appearance from the indurated areas seen in our cases of early carcinoma. In some cases of benign hypertrophy with a history of suppurative conditions, adhesions, and irregular areas of infiltration suggested carcinoma strongly, and in one such case the diagnosis of carcinoma was held until after a

suprapubic drainage the prostatitis disappeared, and along with it the posterior surface of the prostate became smooth and elastic, so that the benign character of the enlargement was at once evident and demonstrated by perineal prostatectomy.

*Seminal Vesicles.*—As shown in the above tabulation the seminal vesicles were frequently involved. The seminal vesicles, one or both, were indurated in 88 cases and more or less enlarged in 82 cases. It is probable that both of these figures should be a little larger, as the seminal vesicles were in some cases difficult to reach, owing to the thickness of the perineum, the fatness of the patient or the large size of the prostate. Only 14 cases are recorded in which both seminal vesicles were normal in consistence and size, and therefore probably not involved by the carcinoma. These 14 cases are of considerable interest. In all but 2 cases the diagnosis of carcinoma was confirmed by study of tissues removed at operation (radical excision 3, perineal prostatectomy 9). In 2 of the cases, in which the radical operation was performed, although the seminal vesicles were free from invasion, there was a small area of carcinoma just above the prostate, beneath the anterior part of the trigone and adjacent to the lower end of the seminal vesicles. In the other case the disease had not spread beyond the upper limit of the prostate. In all 3 of these cases the diagnosis was made before operation. In 2 cases (seen in 1901 and 1903) the malignant nature of the disease was not recognized either before or during the operation (1 suprapubic and 1 perineal prostatectomy), but the microscope subsequently showed carcinoma. In both of these cases the disease had not spread above the prostate, and a radical operation should have given good results.

As noted in the above table there were 18 cases in which only one of the seminal vesicles was found to be involved, and in view of the cases of apparent cure, detailed above, it would seem probable that in several of these cases the upper portion of the vesicle was free from disease and that a radical operation might have been performed with success.

*Interventricular Space.*—As noted in the above table the space between the seminal vesicles above the prostate was involved in a great many cases, and had careful notes in regard to this region been made in some of the cases seen several years ago, it is probable that the percentage of involvements of this region would be even greater than that of the seminal vesicles. As a rule, when the disease spreads above the prostate it invades the soft tissues beneath the trigone adjacent to the ejaculatory ducts, the lower ends of the vasa deferentia and seminal vesicles usually forming a small plateau of induration which, in some cases, occupies a breadth of 1 cm. on each side of the median line. In other cases it extends to the outer side of each vesicle, thus forming a plateau continuous with the prostate, and often difficult to distinguish from it. Further progress generally consists of involvement of the interior of one or both seminal vesicles and tissues between them and the bladder, thus forming usually a bicornate mass of induration with a sharp concave upper border (determined by the lower limit of Douglas's pouch of peritoneum). The posterior surface of these supraprostatic invasions is

usually smooth (on account of the strong fascia covering them), but not infrequently they are irregular and nodular. The induration like that of the prostate is usually very great, often of stony hardness, and the whole mass is fixed by adhesions to the pelvic wall. When a portion or all of the seminal vesicles escapes invasion it may form a soft, somewhat elastic layer between the rectum and the subtrigonal infiltration and lead to mistake, as in one of my cases in which the radical operation was performed on the assumption that the disease had not progressed far above the prostate. In this case, although the upper portions of the seminal vesicles were healthy, the disease had reached the peritoneum by traveling in the space between them and the bladder. A more careful examination, especially making use of the cystoscope in the bladder and the finger in the rectum, should have demonstrated this.

*Membranous Urethra.*—The above tabulation also shows a considerable involvement of the membranous urethra, and here again the figures are probably less than the truth, because in many of the early cases the records are not complete in this respect. As shown here, however, there was more or less thickening of the membranous urethra in 32 cases, and in 61 cases distinct induration, often of stony hardness. In most of these cases the invasion was continuous with that of the prostate and simply surrounded the membranous urethra. In no cases was there any evidence of ulceration into the membranous urethra, which like the prostatic urethra very seldom becomes ulcerated in cases of carcinoma.

In a few cases the disease spread to the perineum from the membranous urethra, involving the fascia back of the triangular ligament on one or both sides; this was recorded in 5 cases. In only 3 cases did the disease extend in front of the triangular ligament, and in these the corpus spongiosum had become infiltrated. In one interesting case the corpora cavernosa were apparently completely replaced by carcinomatous infiltration which extended up to the glans penis, thus producing a constant erection of almost complete character which was due entirely to the carcinoma. In this case, as well as the two mentioned above, there was no ulceration of the urethra and no hematuria.

*Rectum.*—As remarked above, the two layers of the aponeurosis of Denonvilliers act as a powerful barrier against backward invasion of carcinoma of the prostate, and this is abundantly proved by the fact that among these 111 cases there is only 1 in which the mucous membrane of the rectum was invaded, and 13 cases in which the prostate was adherent to the rectum. In many of the later cases, however, the adhesions were probably only of such inflammatory character as is often seen adjacent to malignant growths and do not necessarily mean invasion. While the aponeurosis of Denonvilliers (Fig. 329) protects the rectum from invasion it does not prevent constriction of its lumen either by the bulk of the carcinomatous mass or by constriction in the region of the seminal vesicles through the development of a ring of carcinoma around the rectum. This was present in only a few cases when first examined; but from letters I have received concerning the progress of the disease I am satisfied that it has occurred not infrequently later in the disease. In fact, it forms one of the most troublesome later com-

plications, leading to a partial or almost complete stricture of the rectum, severe constipation, and occasionally requiring colostomy.

*The Bladder.*—The conditions present in the bladder have been studied in various ways: in 49 cases by cystoscopy; in 6 cases by suprapubic cystotomy; in 21 cases by perineal prostatectomy, and in 12 cases by autopsy. In not all cases were the notes full in every respect, so that the figures in the tabulation given below are not always complete. They show, however, very forcibly the fact that intravesical tumor growth is extremely rare and only occurs very late in the disease, and then in only a small percentage of cases, that the trigone is often thickened, and that the changes at the prostatic orifice consist usually in thickening or possibly slight rounding of the median portion. In those cases in which considerable enlargement of the lateral lobes was found it was probably due, in all cases, to a coexistent adenomatous hypertrophy.

#### CONDITIONS WITHIN THE BLADDER.

	By cystoscopy.	Suprapubic operative examination.	Perineal operative examination.
Median portion:			
Normal . . . . .	1	3	..
Slight bar . . . . .	23	..	8
Considerable bar . . . . .	15	1	6
Rounded lobe . . . . .	5	2	3
Right lateral:			
Normal . . . . .	16	3	..
Slight . . . . .	25	2	17
Considerable . . . . .	5	..	2
Left lateral:			
Normal . . . . .	17	3	..
Slight . . . . .	22	2	17
Considerable . . . . .	7	..	2
Trigone:			
Negative . . . . .	13	2	..
Thickened . . . . .	17	3	8
Ulcerated . . . . .	..	..	..
Tumor . . . . .	..	..	..
Ureteral ridges:			
Negative . . . . .	20	3	..
Elevated . . . . .	15	1	..
Ulcerated . . . . .	..	..	..
Tumor . . . . .	2	..	..
Rest of bladder:			
Negative . . . . .	21	4	16
Ulcerated . . . . .	1	..	..
Tumor . . . . .	1	1	..

In the 12 *autopsies* of which we have careful examinations there were only 2 in which the disease had spread into the bladder in the shape of a tumor or ulcer. In both of these cases suprapubic cystotomies had been performed several months before, and although the base of the bladder was found invaded there was no ulceration or any form of intravesical tumor.

As a result of our clinical studies we feel justified in saying that when no hypertrophy is present the enlargement of the prostate in cancer is generally not great; that the growth is almost invariably upward into

the space between the seminal vesicles and around the vasa deferentia beneath the trigone; that the changes at the vesical orifice consist usually in a thickening of the median portion of the prostate, with sclerotic condition of the internal sphincter (making a urethral orifice which is difficult to dilate), and that in some cases the median portion is in the shape of a moderately thickened bar, but rarely a rounded intravesical lobe; that the trigone very frequently becomes thickened and sometimes considerably elevated from infiltration, but that the mucous membrane everywhere (bladder and urethra) preserves its integrity wonderfully; that it rarely becomes ulcerated, and then only very late in the disease.

*Stricture of the prostatic urethra* was discovered in 8 cases and probably existed in others. In only 1 case was it impermeable to filiforms and all other instruments. Most often it was merely a contracture through which small straight instruments (Nélaton catheters) could be passed, but impermeable to Coudé catheters and cystoscopes.

*Suburethral Thickening.*—The condition found between the cystoscope in the bladder and the index finger in the rectum is a very important diagnostic sign. An invasion of the posterior commissure of the prostate leads to considerable thickening and induration, and when examination is made with the finger in the rectum and cystoscope in the urethra an increase in the thickness is made out it is often impossible to feel the instrument anywhere along the urethra, and particularly in the region of the median portion. If the disease has progressed above the upper end of the prostate, thus forming an intervesicular plateau, it is usually impossible to feel the beak of the instrument in the bladder. This condition is entirely different from that found in benign hypertrophy, in which it is usually possible to palpate the shaft of the instrument through the posterior commissure (which is usually not much increased in size until the median portion of the prostate just beneath the vesical orifice is reached), and it is very rare to find even in the median portion a marked induration in benign hypertrophy, and the beak of the instrument can generally be felt through the bladder unless the enlargement of the median portion is considerable.

**Treatment.**—There is such a wide variety of opinion as to the proper treatment of cancer of the prostate that it seems necessary to furnish here as complete a statistical study as possible. I will first give my own experience and then records from the literature. My cases comprise the following:

	Cases.
I. Radical operation . . . . .	10
II. Subtotal, excision . . . . .	4
III. Conservative (partial) perineal prostatectomy . . . . .	71
IV. Suprapubic prostatectomy . . . . .	2
V. Bottini electrocautery operation . . . . .	8
VI. Castration . . . . .	2
VII. Suprapubic drainage . . . . .	12
VIII. Perineal drainage . . . . .	2
IX. Treated by catheterization . . . . .	39
X. No catheter or operative treatment . . . . .	29
Total cases studied . . . . .	179

I. *Technic of the Radical Operation.*— Described first in the *Johns Hopkins Hospital Bulletin*, October, 1905.

The patient is placed in the exaggerated lithotomy position and an inverted U perineal incision made, as in the operation for simple hypertrophy of the prostate, the successive steps of which are followed until the tractor has been inserted through a urethrotomy wound of the

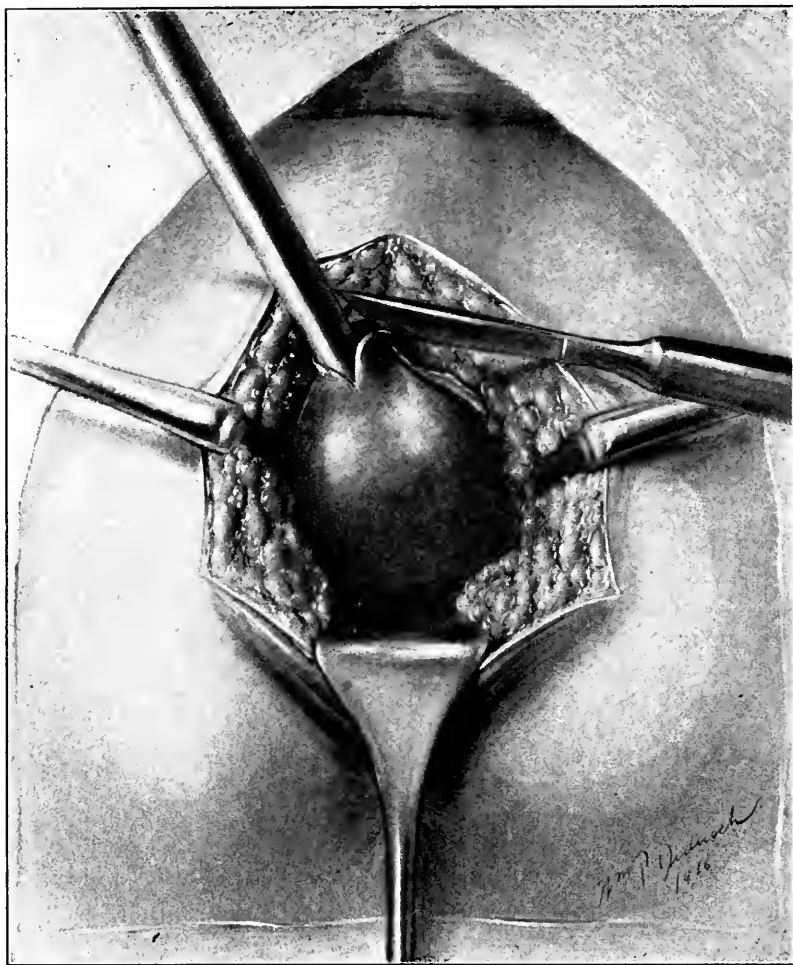


FIG. 334.—Transverse section of membranous urethra at apex of prostate.

membranous urethra, and the posterior surface of the prostate has been exposed, largely by blunt dissection. If there is then any doubt in the mind of the operator as to the malignant nature of the disease an incision is made through the capsule and a section removed for examination, frozen sections being made if necessary to establish the diagnosis, when either the simple prostatectomy for hypertrophy or the radical

operation for cancer can be performed as the case requires. In the case of cancer the next step after exposing the posterior surface of the prostate is to follow the fascia of Denonvilliers upward and expose the posterior surface of the seminal vesicles as much as possible by blunt dissection. It is important here to carry the dissection along the lateral surface of the gland, hugging the capsule, and passing between it and the anterolateral pelvic fascia shown in Fig. 240. By elevating this fascia carefully from the anterolateral surfaces of the prostate (Fig. 336) the nerves and rich blood supply of this region are avoided (Figs. 337 and 338). Then the membranous urethra is divided in front of the tractor, as shown in Fig. 334. The handle of the tractor is then depressed markedly and the fascia elevated, the operator hug-

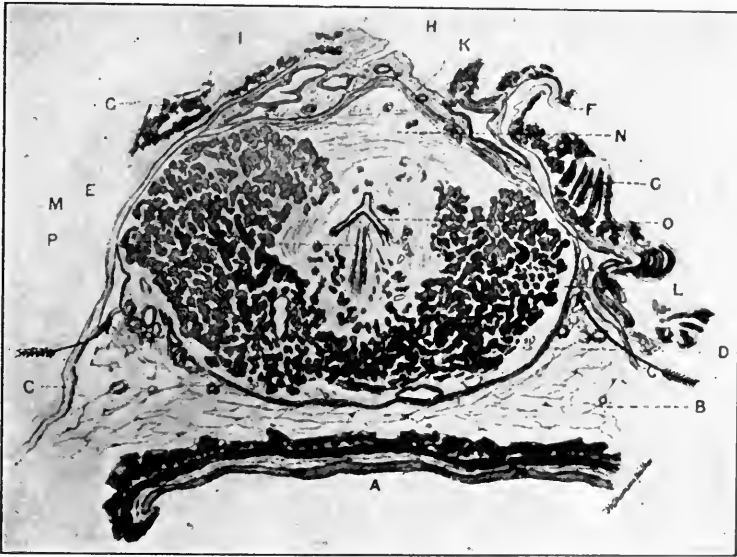


FIG. 335.—Transverse section of prostate and rectum. Arrows indicate points of beginning dissection beneath anterior prostatic fascia.

ging the anterior surface of the prostate, efforts being previously made to push away the anterior plexus of veins by blunt dissection. By thus going between the lateral periprostatic fascia and the prostate it is possible to avoid much hemorrhage. Hemorrhage should be controlled as much as possible by ligatures and then by gauze packs, which should be held tightly against the posterior surface of the pubes and the triangular ligament by means of a retractor. The seminal vesicles should be freed further (Fig. 335).

The prostate is drawn outward as far as possible, thus exposing the anterior surface of the bladder, which should be punctured, as shown in Fig. 339, just above the prostatovesical juncture. This wound is now enlarged on each side by scissors, the line of division being close to the prostatovesical juncture (Fig. 340), until the trigone is exposed, as

shown in Fig. 341. With the scalpel a curved incision is made across the trigone, thus leaving the upper angles of the trigone intact, and being careful to do no injury to the ureters. By blunt dissection the bladder is pushed upward (Figs. 342 and 343) the seminal vesicles are then exposed, as shown in Fig. 344, and the vasa deferentia picked up with a blunt hook and divided with scissors as high up as possible. (In

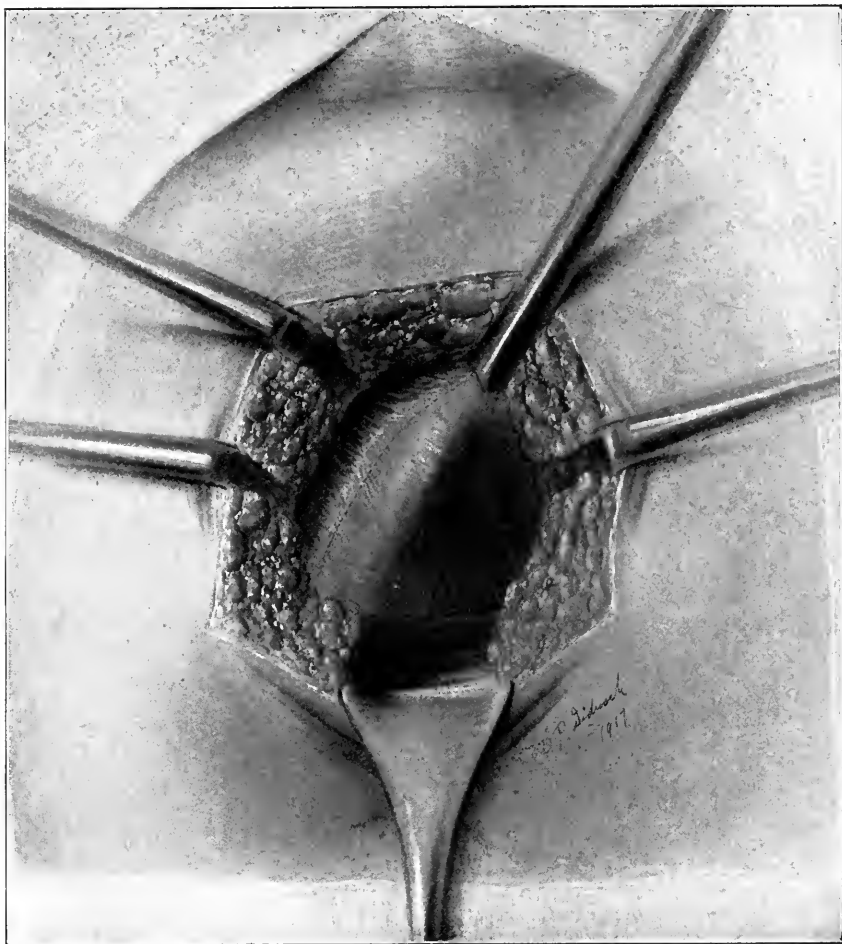


FIG. 336.—Dissection to elevate lateral fascia from capsule of prostate.

doing this it should be remembered that the vasa deferentia pass around the lower end of the ureters.) The deeper attachments of the seminal vesicles are then freed and the mass, consisting of the prostate, urethra, cuff of the bladder, seminal vesicles, and about 5 cm. of the vasa deferentia, is removed in one piece (Figs. 345 and 346). Hemorrhage is again encountered in the last step above described, owing to the fact that the prostatic plexus of veins, which pass up along each side of the

prostate, is closely attached to the lateral border of the seminal vesicle, but this can easily be controlled by ligatures or long clamps. The bleeding which comes from the vesical wound is easily controlled by the subsequent sutures, which are placed so as to anastomose the bladder

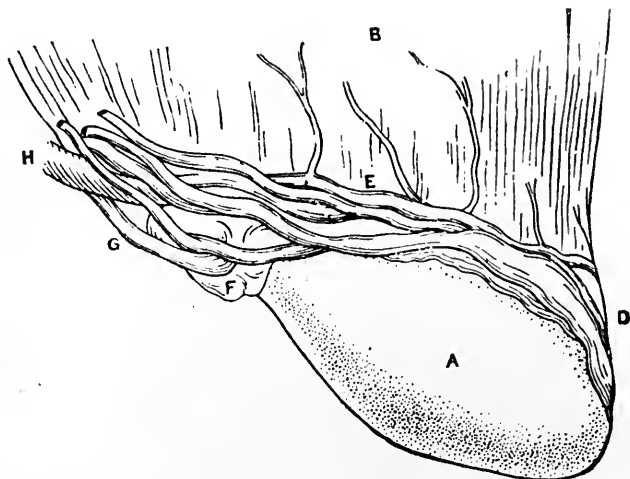


FIG. 337.—Prostatic plexus of veins, side view. A, prostate; B, bladder.

(Fig. 347) with the membranous urethra, and completely close the vesical wound. This is easily accomplished, as shown in Figs. 247 and 248. As seen here the anterior wall of the bladder is drawn down and fastened

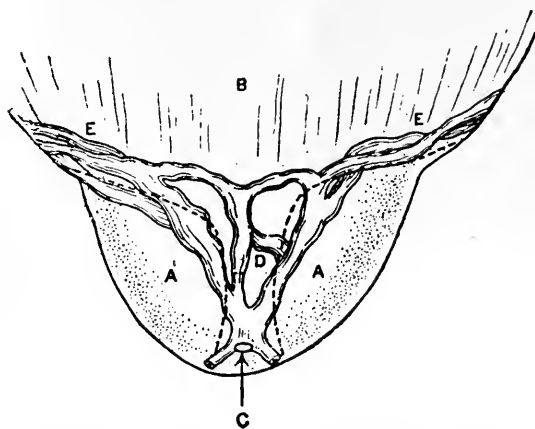


FIG. 338.—Prostatic plexus of veins, anterior view.

to the stump of the membranous urethra by means of interrupted chromicized catgut sutures. After forming the anastomosis with the urethra a considerable vesical wound is left posteriorly, but it is easily closed by a continuous chromicized catgut suture (Fig. 350).

A retained rubber catheter, which should be inserted before the vesico-urethral anastomosis is made, is fastened to the glans penis with adhesive plaster. After placing light gauze packing in the depths of the wound the levator ani muscles are approximated with two or three interrupted sutures of catgut, so as to protect the rectum against

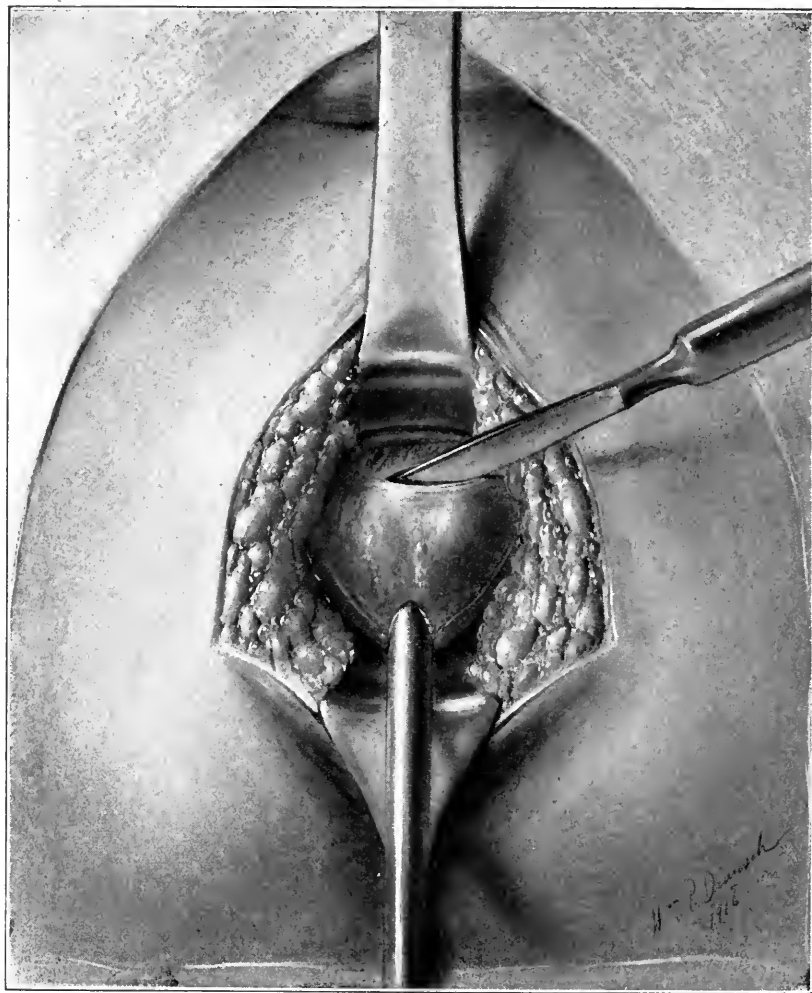


FIG. 339.—Incision into bladder, just above prostatovesical juncture.

pressure from gauze (Fig. 351), and the external wound is almost completely closed with interrupted sutures of catgut (Fig. 352). In some instances I found it difficult to place ligatures around hemostatic clamps which were deeply placed, and have therefore not removed the clamps but allowed them to emerge with the gauze packing from the anterior angle of the wound (they were removed twenty-four hours

later). If careful attention has been given to the prevention of hemorrhage and an infusion has been begun early in the operation there should be little or no shock.

*The treatment during convalescence* is very similar to that employed after perineal prostatectomy, viz., water in abundance, urotropin, the patient allowed to sit up as soon as possible, daily irrigations of the bladder with small amounts of boracic acid solution, not more than 30 c.c. being injected at a time. The gauze packs are removed in two or three days and the urethral catheter in a week, but the silkworm-gut sutures are allowed to loosen and no attempt is made to extract them

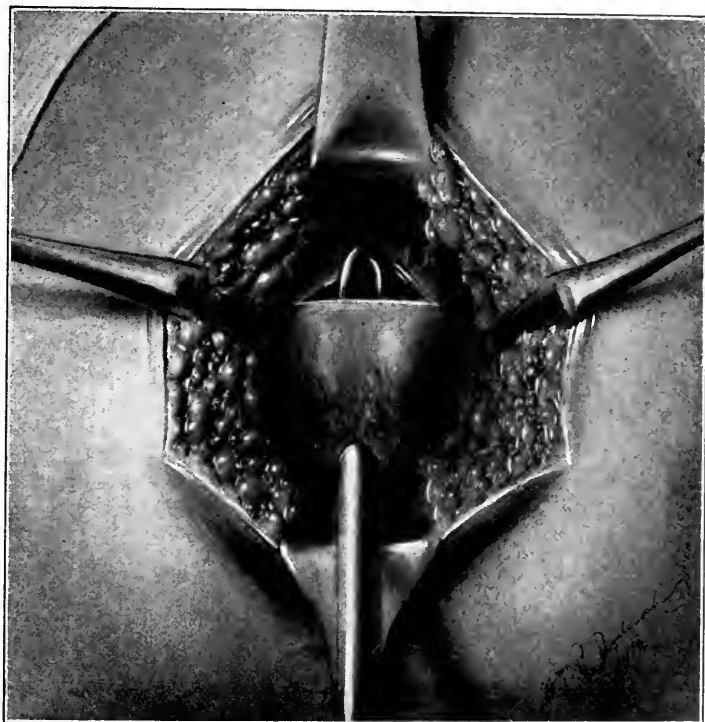


FIG. 340.—Tractor turned to facilitate opening bladder.

forcibly for about eighteen days. No difficulty is experienced in getting a good approximation and wound healing, and little or no stricture formation has been encountered at the point of vesico-urethral anastomosis. Sounding is not necessary. None of my patients have had persistent fistulæ.

*Analysis of the Ten Cases in which the Radical Operation was Performed.*—The ages of the patients were seventy, sixty-four, sixty-five, sixty-four, seventy-five, sixty-eight, sixty-nine, seventy-seven, seventy, and fifty-eight years respectively, and symptoms had been present eleven months, three years, four years, one year, eight months, one year,

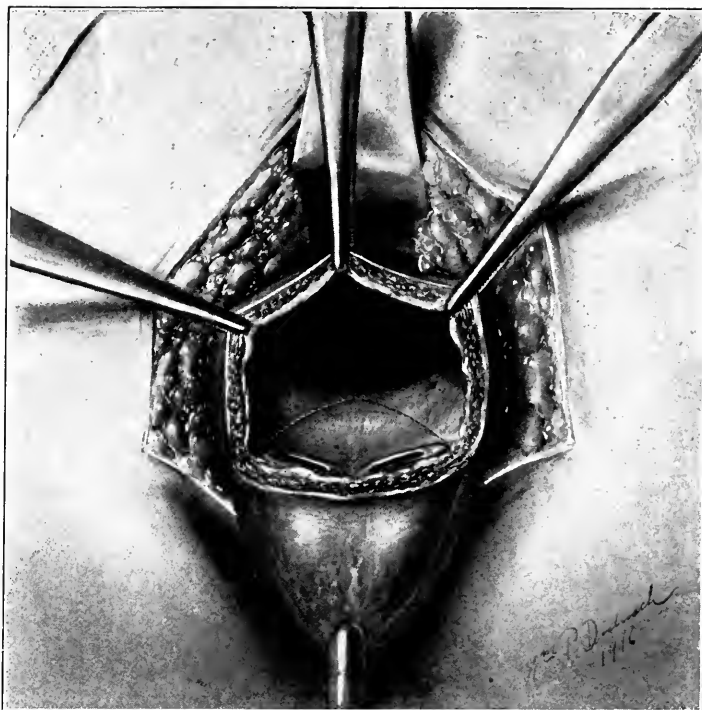


FIG. 341.—Bladder opened. Dotted line shows site of incision across trigone, below ureters.

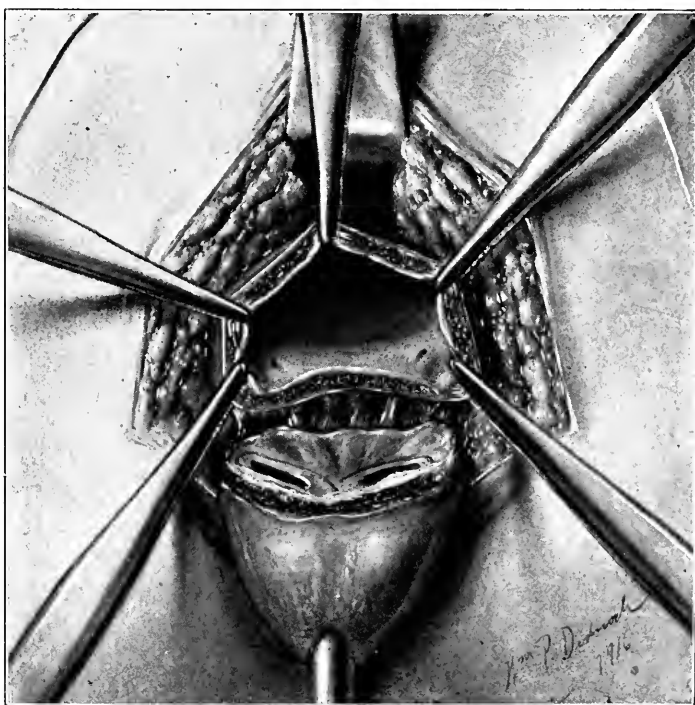


FIG. 342.—Trigone divided, blunt dissection of seminal vesicles begun.

eight months, two years, three years, and two and a half years respectively. Physicians had been consulted and treatment given eight months before in one case, and seven months before in another. In both of these cases an osteopath was employed who gave prostatic

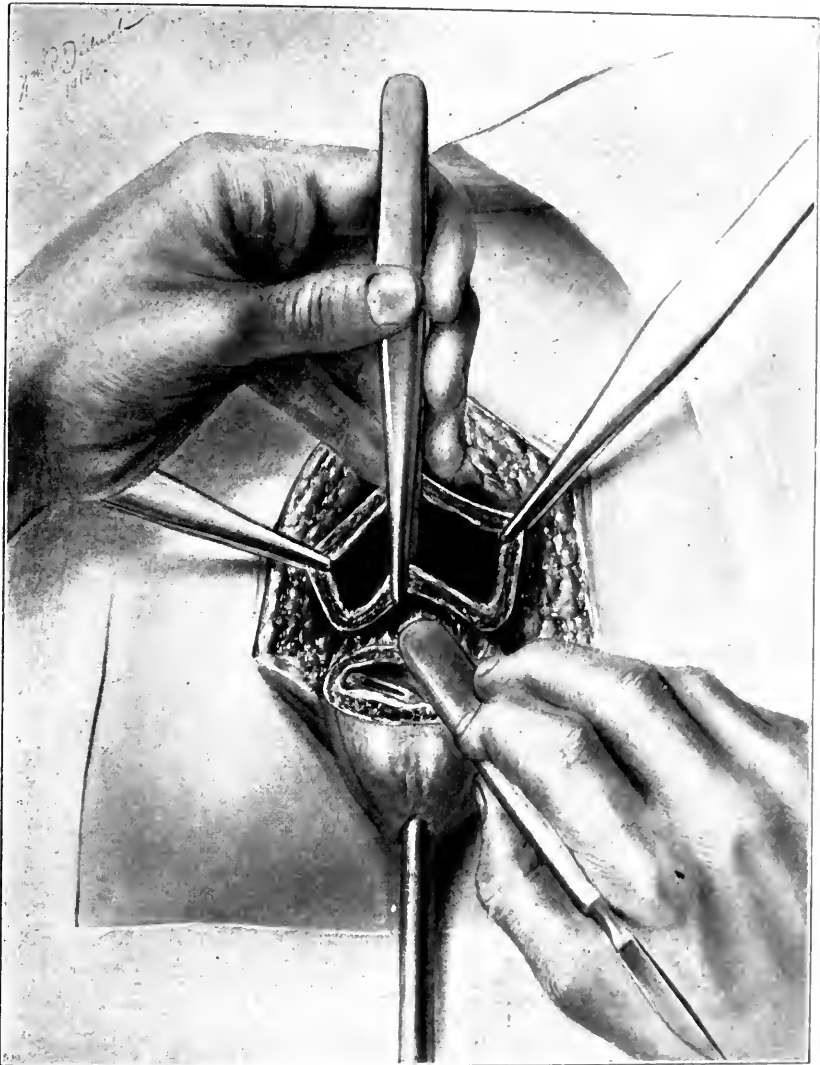


FIG. 343.—Bladder pushed upward by blunt dissection.

massage, thus losing valuable time. One patient consulted a physician for prostatic trouble two and a half years before. One case was subjected to a Bottini operation six months before admission. In all cases sufficient symptoms were present to warrant rectal examination by

which diagnosis could have been made long before the patient applied for treatment with us.

The initial symptoms were difficulty and frequency of urination in all cases except Case I and Case VII, in which the first symptom was pain in the urethra. Four patients (Cases II, IV, VI and VIII) had never suffered any pain. In 4 cases pain either local or referred was a prominent symptom. One patient had pain only on ejaculation, and another only slight pain in the buttocks. On admission, urination was extremely

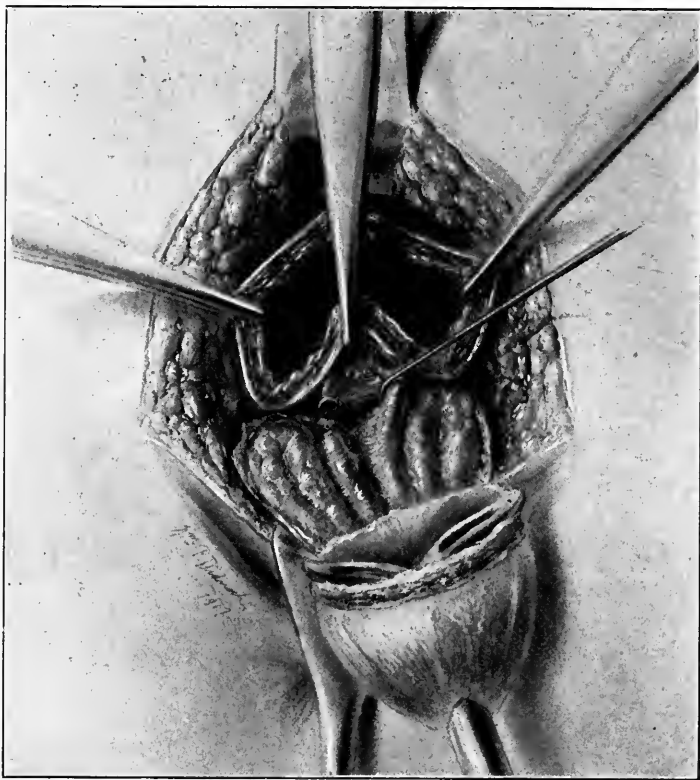


FIG. 344.—Seminal vesicles and vasa exposed, previous to division of vasa and removal of seminal vesicles and prostate.

frequent and difficult in 5 cases. In 1 case a catheter was used twice daily. In 3 cases there was little difficulty, and in 2 cases the patient only got up once at night to urinate, and only 2 patients had had hematuria.

The prostate was described as considerably enlarged in 4 cases, moderately in 3 cases, and slightly enlarged in 3 cases. There was marked induration in all cases, involving the whole prostate in 4 cases. In Case IV the marked induration was confined to half of the prostate, the other half being very slightly indurated.

In 3 cases (Cases VII, VIII and X) the carcinoma consisted of one very hard circumscribed mass or lobule, which in each case projected



FIG. 345.—Photograph of specimen. Case I, posterior view.

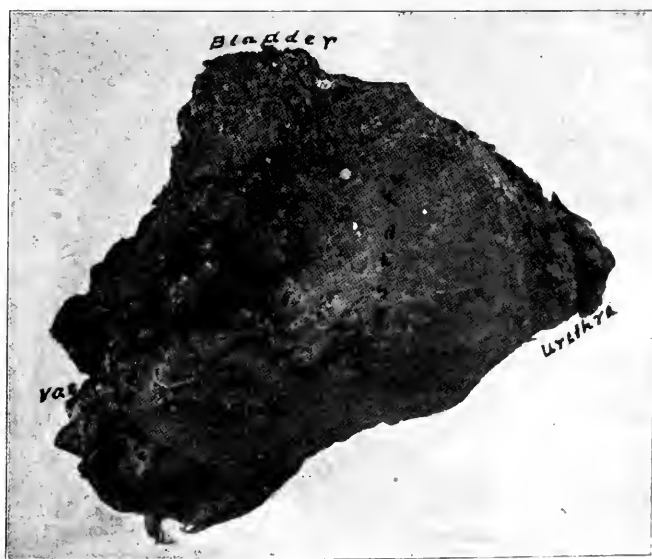


FIG. 346.—Photograph of specimen. Case I, side view.

from the general level of the left lateral lobe, but was still well encapsulated. The rest of the prostate showed adenomatous hypertrophy.

The seminal vesicles were found on rectal examination to be free from infiltration or induration in 8 cases. An area of induration between the seminal vesicles was present in 4 cases. The catheter showed 400, 300, 500, 400, 80, 600, 60, 160, 20 and 10 c.c. residual urine respectively.

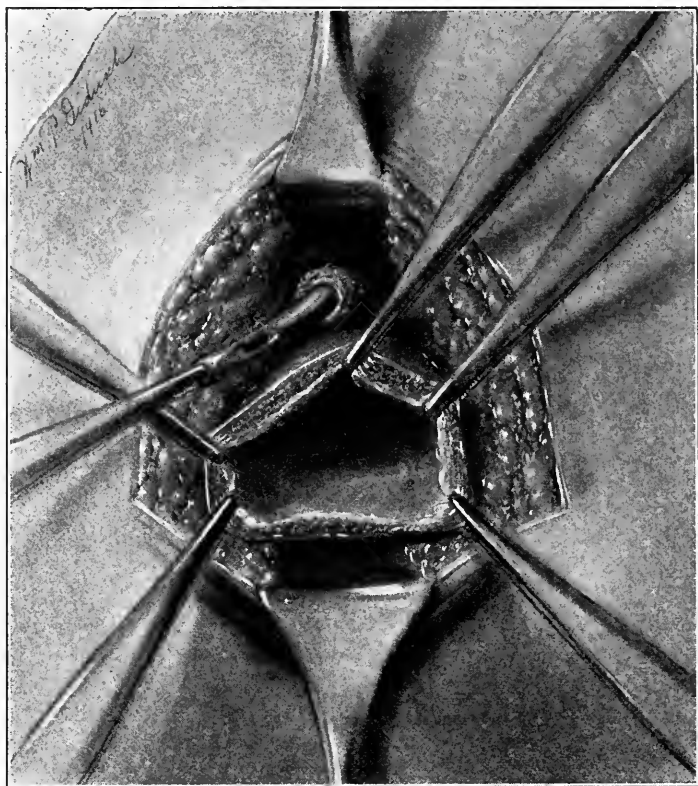


FIG. 347.—Showing condition after excision of prostate, trigone and vesicles, and structures to be anastomosed, bladder and membranous urethra.

The cystoscope showed a slight elevation of the median portion in 5 cases, in 3 cases a small, definitely rounded median lobe with a shallow cleft on each side, and in 1 case a large median lobe.

The lateral lobes were scarcely at all enlarged intravesically in all cases but one in which they were moderately enlarged. There was generally not even a sulcus between them in front, but in 2 cases it was shallow. In 2 cases enlargement of the anterior portion of the prostate was present. The vesical mucosa was everywhere intact, but the cystoscope showed in 2 cases an elevation of the trigone, which involved only the anterior portion in Case II. In Case III the trigone was con-

siderably elevated and irregular, extending out on the left side as far as the ureter. In 8 cases the trigone was negative.

At operation the lower ends of both ureters were intentionally excised for a short distance in Case II, the operator thinking that the disease had reached this point. This was a mistake, as it was afterward found that the induration was inflammatory in character. In Case V the lower end of the left ureter was involved and had to be excised. This patient died of shock, and autopsy showed that while the seminal

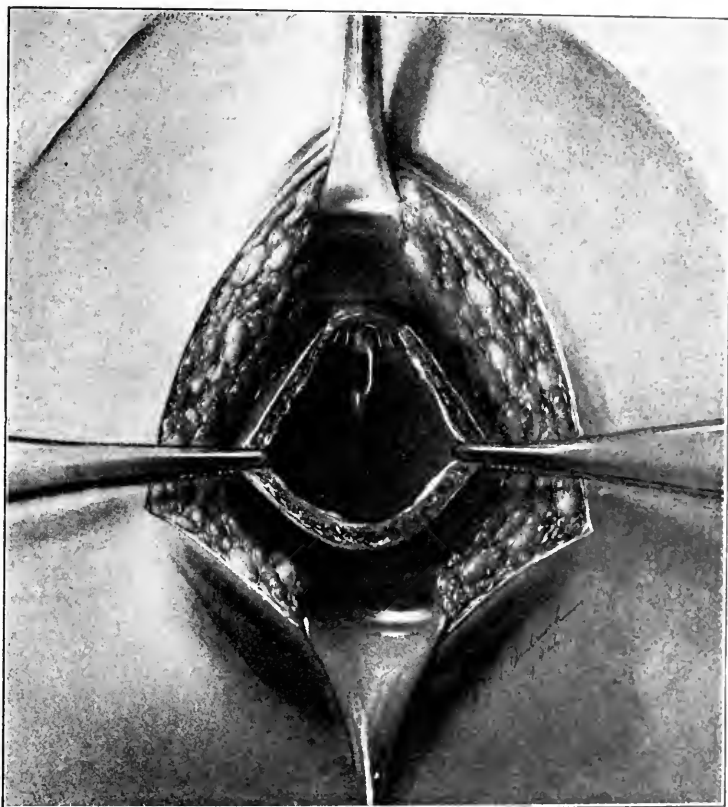


FIG. 348.—Anastomosis of urethra and anterior wall of bladder, with chromicized catgut tied outside.

vesicles were free the disease had travelled into the peritoneal cavity. The cystoscopic evidence of elevation of the whole trigone should evidently militate against the radical operation, as shown by this case. In Case III the lower end of the left ureter was unintentionally divided with scissors in making the division along the left lateral wall of the bladder. Anastomosis was made high up and no inconvenience resulted (the patient living three years). In 9 cases the operation was carried out with apparent success and without shock, but a study of the

specimen removed showed carcinoma near the upper limit in 2 cases (Cases I and III). In Case V (patient dying of shock) autopsy showed extensive carcinoma of the peritoneum and retroperitoneal glands, although the bladder and seminal vesicles were free from invasion. In Case I the patient died nine months after the operation as a result of traumatism and infection, caused by an attempt to remove a stone adherent to a silk suture. Autopsy showed a very small area of recurrence 1 cm. in diameter back of the bladder. In Case III the patient

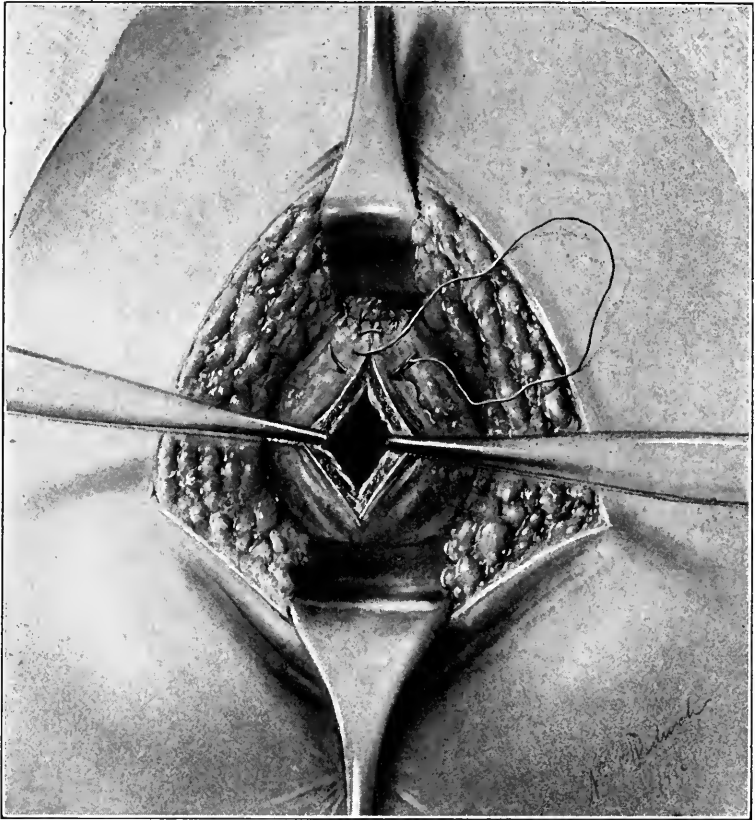


FIG. 349.—Anastomosis completed; remainder of bladder opening being closed with continuous chromicized catgut.

lived over three years in comfort, but autopsy showed metastases in various parts of the body, the bladder and urethra, however, being free from ulceration. In Case II, in which the patient died six weeks after the operation from ascending renal infection, as a result of the intentional but injudicious division of the two ureters, extremely careful examination of all the pelvic tissues at autopsy with numerous sections taken for microscopic study failed to reveal any evidence of carcinoma, and it seems probable that the disease had been completely eradicated. Two

patients have apparently been cured. One died six and a half years after the operation and the other is well five and a half years after the operation. In both of these cases the operative specimens showed that the disease had not reached the upper line of excision. Three patients operated upon two years ago are alive and apparently well.

In the first cases there was incontinence when the patient was on his feet, but when in bed and in a sitting posture there was fair control. In more recent operations control has been much better, in the ninth case

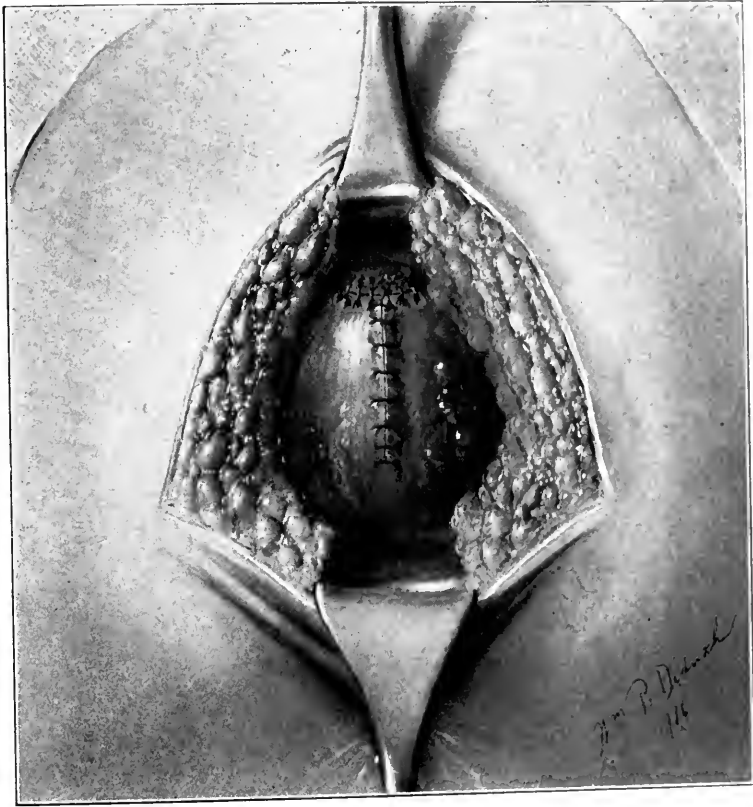


FIG. 350.—Closure of bladder completed—urethral catheter drainage.

hardly any incontinence, and in the tenth case no incontinence at all, the patient voiding naturally with normal force only three or four times by day and none at night. This has been accomplished by using great care to elevate the anterior layer of pelvic fascia, which encloses the lateral and anterior aspects of the prostate, with the nerves and blood-vessels of that region. This not only obviates hemorrhage but preserves the vascular and nervous supply of the triangular ligament and sphincter, and thus prevents incontinence and removes the one objection to the operation.

As a result of the experience gained in these 10 cases it may be said that the operation should not be attempted when the infiltration extends more than a short distance beneath the trigone, as determined by the cystoscopic examination with the finger in the rectum and the cystoscope in the urethra; nor where the upper portions of both seminal vesicles are involved, nor where an extensive intervesicular mass or indurated lymphatics or glands or involvement of the membranous urethra or muscle of the rectum shows that the disease is manifestly too far



FIG. 351.—Levator ani muscles approximated with catgut suture. Gauze drainage to retrovesical space.

progressed; that the corners of the trigone containing the ureteral papillæ should be left intact with sufficient tissue below them to ensure proper suture and to leave their openings free from constriction, 1 or 2 cm. above the wound; that the hemorrhage should be carefully checked (by hugging the capsule, injury of the periprostatic plexus being largely avoided); that silk should never be used but occasional stitches of silk-worm gut should be employed in addition to catgut in making the urethrovesical anastomosis; that when the operation is attempted early

it can be performed without much danger or great difficulty, and with excellent chance of cure; that only 7 of the 10 cases above recorded were suitable for the radical operation, and that in all of these the disease was apparently completely removed. Only 2 with definite recurrence have been found. It seems probable that radical cures have been obtained in at least 5 cases.



FIG. 352.—Skin closed; subcutaneous catgut continuous suture. Drainage.

*Radical Cures by Partial Prostatectomies.*—Two cases, in which small nodules of cancer were completely removed in the course of perineal prostatectomy for supposed benign hypertrophy, have been radically cured, and therefore deserve mentioning. They are reported elsewhere.

The literature on the radical cure of cancer of the prostate has become fairly voluminous since my first paper in 1906. Interest has been greatly increased by the fact that this subject was assigned for report and discussion at the International Medical Congress in London, 1913, and at the International Association of Urology in Berlin in 1914. At London reports of successful results with the operation were made by

Joly, Wildbolz, Légeu, and others, and at Berlin excellent clinical compilations from the literature were made by Verhoogen, Schapiro, and Wildbolz. The consensus of opinion was that for radical cure radical excision was necessary, and that good results could be expected if the operations were performed early.

II. *Subtotal radical excision of carcinoma*, with conservation of sphincters, and most of the urethra and capsule. This operation has been carried out in 4 cases. The first case showed a well-circumscribed area of carcinoma in the right half of the prostate. The right lateral lobe lay in front of this and was an adenomatous hypertrophy, the left and median lobes of the prostate were also benign hypertrophies. The area was so well circumscribed that I did not perform the typical radical operation but contented myself with removing the right half of the prostate with its capsule, the right lateral wall and floor of the urethra, the suburethral tissues with ejaculatory ducts and lower portion of the right seminal vesicle and vas deferens, all in one piece. The left lateral and median lobes were then excised as usual, preserving the roof, left lateral wall of the urethra and vesical sphincter.

The result was splendid. Perineal fistula closed on the ninth day, patient discharged on the fourteenth day. Report by letter five years later: "Entirely well; urination normal."

Two other patients have been operated upon by a similar technic, also with excellent results, now four years in 1 case, and the method can be recommended in cases in which a small nodule of carcinoma well circumscribed and surrounded by healthy tissue is present. Great care must be exercised, however, in choosing cases, and the radical operation is generally the safer to employ.

III. *Typical Conservative (Partial) Prostatectomy*.—Seventy-one cases. This operation was done with no idea of radical cure but merely to remove the obstruction to urination. In 2 cases, however, a small nodule of carcinoma was completely excised in the removal of the lateral lobes.

In 1 case the carcinoma lay adjacent but not within an adenomatous lobe, but was radically removed, as shown by the fact that the patient is alive now, eleven years after operation.

The other case was one of obstructive prostatitis, the microscope showing a small but definite nodule of cancer in the tissues removed from one lobe. The patient is alive and well now, seven years after operation.

In 71 cases conservative perineal prostatectomy was carried out to remove the obstruction and thus furnish relief from very difficult and painful urination or a painful catheter life.

Discovery of the fact that a manifestly incomplete operation of this character could give lasting functional results came accidentally, but has now been tried sufficiently to make it an operation of election in many cases.

It has indeed been surprising to find patients with extensive carcinoma of the prostate and seminal vesicles permanently relieved of

obstruction to urination by a simple shelling out of the carcinomatous tissue from the lateral and median portions of the prostate, but such is most often the case.

The operation is as follows: A description of the principal steps in the operation of conservative perineal prostatectomy seems desirable here, as many of the steps are the same as for the radical operation for cancer of the prostate.

*Position of the Patient.*—The exaggerated dorsal position of the patient is the most satisfactory and the perineal board devised by Halsted is admirably suited for this purpose. The perineum should be so elevated that it is almost parallel with the floor, thus allowing excellent retraction of the rectum and splendid exposure of the posterior surface of the prostate. After placing the patient upon the table, before elevating the thighs, a No. 24 F. sound should be inserted into the posterior urethra, to be used subsequently as a guide for urethrotomy. If the operator waits until the patient is placed in the urethrotomy position he will frequently find it difficult to introduce the sound through the triangular ligament.

*Cutaneous Incision.*—The inverted U cutaneous incision unquestionably gives a far better exposure than a median incision. The apex should be just over the posterior part of the bulb, about two inches in front of the anus, and the lateral branches directed outward and backward parallel to the ischiopubic ramus, each about two inches in length. The incisions are carried through the skin, fat, and superficial fascia, and then by blunt dissection with the handle of the scalpel and the index finger of the left hand the space to each side of the central tendon is opened up. In this way it is very simple to open up by blunt dissection very quickly a space on each side reaching as far as the triangular ligament. In so doing the levator ani is pushed backward and outward on each side and the transversus perinei muscles are pushed forward (Fig. 353).

*Exposure of the Membranous Urethra.*—The bifid retractor is inserted, as shown in Fig. 354. Traction upon this instrument gives an excellent exposure of the narrow band of central muscle and tendon and greatly facilitates the division close to the bulb without injuring this hemorrhagic structure. After the central tendon has been completely divided and the posterior surface of the bulb freed it is well to insert a grooved retractor by which the bulb and triangular ligament and external sphincter are drawn upward and a better view obtained of the recto-urethralis muscle, which lies between the two branches of the levator ani and covers the membranous urethra, toward which it draws the anterior wall of the rectum. In dividing the recto-urethralis muscle, care should be taken not to injure the rectum, which is often drawn forward so that it lies almost in front of the membranous urethra. It nearly always covers the apex of the prostate. As soon as the recto-urethralis has been thoroughly divided it is easy, by blunt dissection, to push the rectum backward and thus obtain a good view of the membranous urethra, the bulb being drawn forward along with the muscular

structures of the triangular ligament. The membranous urethra is then opened upon the sound and the edges picked up with artery clamps, being sure to secure the mucous membrane. A straight sound is then inserted into the bladder through the urethral wound (an assistant hav-



FIG. 353.—Opening up space on each side of central tendon for conservative or radical operation.

ing withdrawn the sound from the anterior urethra), to open up the way for the prostatic tractor (Figs. 355 and 356). In these cancerous cases it may be necessary to stretch the contracted posterior urethra considerably with a glove-stretcher before it is possible to insert the tractor into the bladder through the perineal urethrotomy wound. Owing to the

pronounced curve of this instrument (Fig. 355) it is sometimes difficult to insert. Sometimes it is well to begin its introduction with the beak turned backward and then to rotate the instrument 180 degrees before carrying it into the bladder. After the instrument has penetrated into the prostatic urethra it is generally advisable to remove the anterior

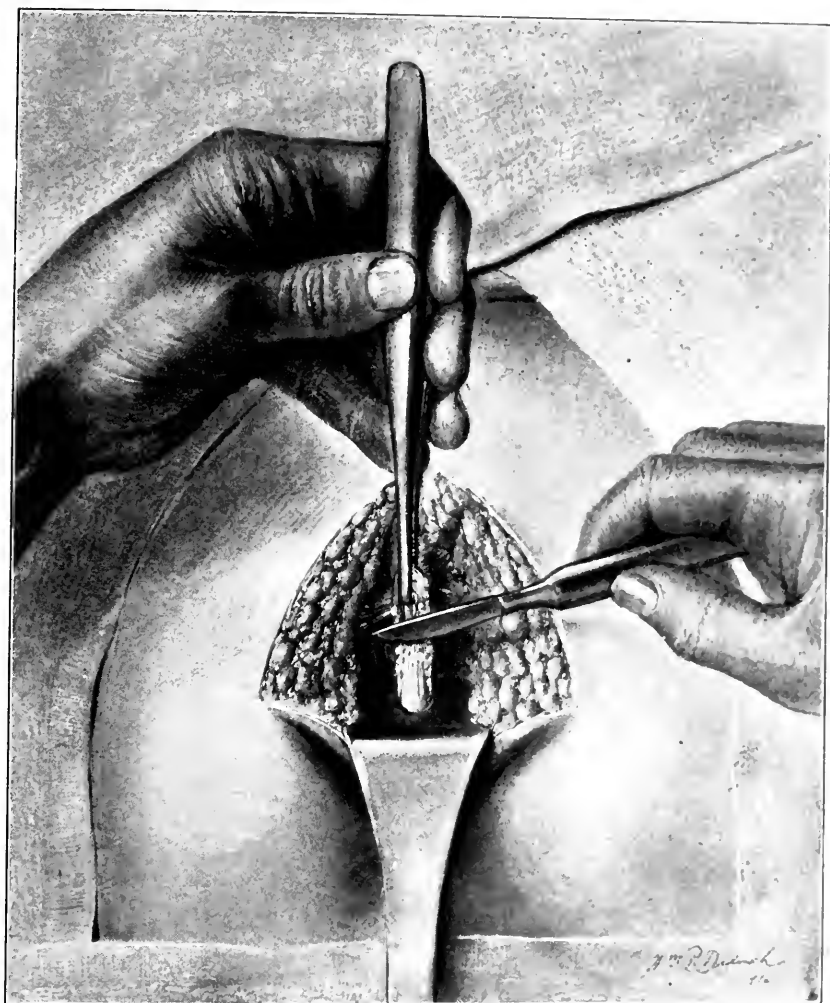


FIG. 354.—Bifid retractor inserted. Division of central tendon and recto-urethralis muscle beneath it.

bulb retractor and thus allow the shaft of the tractor to be carried farther forward. As a rule, little difficulty is experienced in inserting the tractor if one has been careful to secure the edges of the mucosa of the membranous urethra. After reaching the bladder the blades of the tractor are opened out by means of the external handles (Fig. 357), and

after being fixed in this position by means of a set-screw, traction is made upon the prostate and the farther separation of the rectum from the posterior surface of the prostate made. After dividing the rectourethralis muscle and exposing the apex of the prostate one generally finds it necessary to use the knife to divide a layer of fibrous tissue which lies behind the posterior surface of the prostate. After this (the posterior layer of Denonvilliers's fascia) has been divided the rectum can be more easily pushed backward, and one enters, generally with ease, into the space between the two layers of Denonvilliers's fascia and the smooth, glistening surface of the prostate is exposed (Fig. 358). When this layer is properly exposed no difficulty is generally experienced in rapidly freeing the entire posterior surface of the prostate and seminal

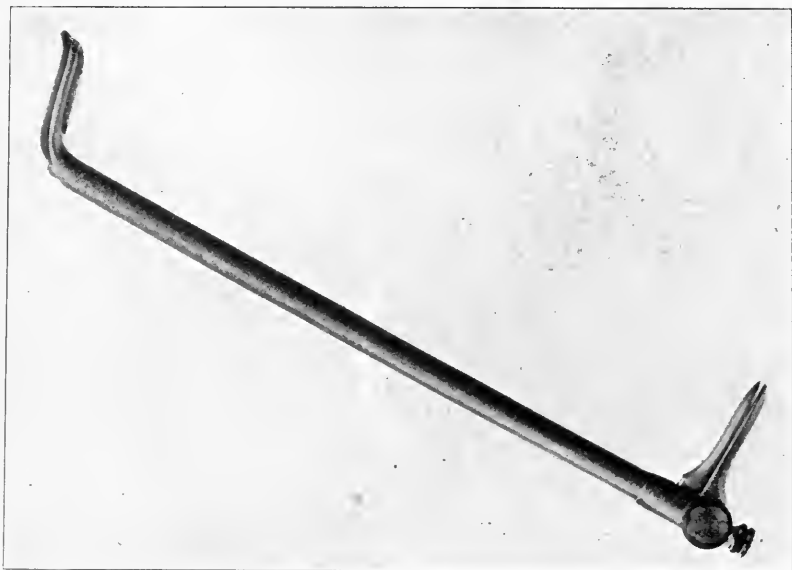


FIG. 355.—Author's prostatic tractor (closed).

vesicles, a good view of which is obtained at once by the insertion of a broad angular retractor posteriorly.

*Incision of Capsule.*—Lateral retractors are so placed that with the posterior retractor drawing the rectum backward, and the prostatic tractor drawing the gland outward a splendid exposure of the posterior surface of the prostate is obtained. An incision is then made through the capsule on each side of the median line for almost the entire length of the posterior surface and about 1.5 cm. deep. These incisions are about 1.8 cm. apart behind and 1.5 cm. apart in front, as shown in Fig. 359. The bridge of tissue which lies between them contains the ejaculatory ducts and the floor of the urethra.

The lateral lobes are then each completely removed, much of this being done by the blunt dissector. When the deep portion is reached—

that is, at the base of the seminal vesicle and the bladder—it is often necessary to use a sharp periosteal elevator or a curette in order to completely remove all of the carcinomatous prostatic tissue in that region. The entire lateral mass of prostatic tissue usually comes away in one piece, but in those cases in which the cancer is confined to the posterior

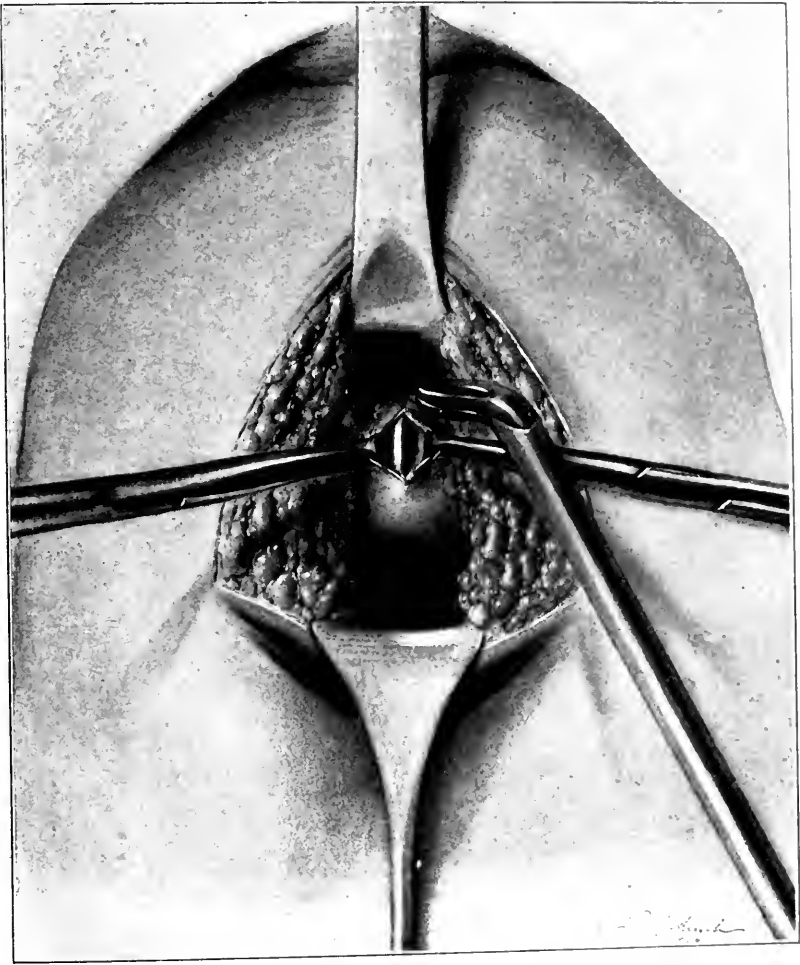


FIG. 356.—Membranous urethra opened on sound, edge caught with clips, tractor about to be introduced.

subcapsular layer in front of which is a hypertrophied adenomatous lobe the latter is usually separately enucleated. After the two lateral cavities are emptied the median portion of the prostate is next attacked. This is indicated in Fig. 360, in which the median portion is shown diagrammatically, caught with a sharp hook. It should be our object here to excise this median suburethral portion without injury to the

ejaculatory ducts which lie behind it (in order thus to avoid epididymitis), and with as little injury to the urethra in front of it as possible. Remaining tissue can be removed with scissors, curette, or rongeur. If a rounded middle lobe is present it may be drawn down and removed through a lateral cavity (Fig. 361). It is then advisable to remove the tractor and dilate thoroughly the external prostatic orifice with large forceps after removal of the tractor. The finger is then carefully inserted through the urethra and an examination of the vesical neck made. As a rule the sphincter will be found tight, or often sclerotic, and thorough dilatation should be made. If there remains any prostatic tissue in the median portion or elsewhere around the orifice this can easily be enucleated or excised, using the finger as a tractor. In

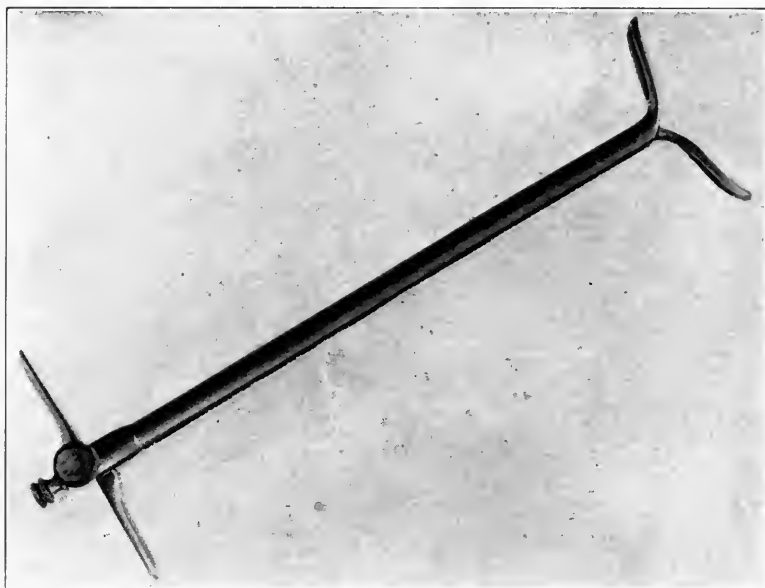


FIG. 357.—Prostatic tractor opened, as in operation.

some cases the carcinomatous infiltration continuous with the median bar and extending beneath the trigone is felt, and it may be advisable to remove this more or less completely (which can usually be done with ease with a curette working upon the finger in the bladder against the trigone as a guide). Care should be taken not to tear a hole in the urethra or bladder, but it is a remarkable fact that although the urethra may have been torn laterally or posteriorly during some of my operations, and in a few cases a small portion excised, the healing in these cases has been entirely satisfactory and there has been no evidence of intra-urethral ulceration or tumor outgrowth through the rent. If a globular median lobe is present this is usually easily enucleable, as in cases of benign hypertrophy. The rest of the operation is similar to that for benign cases: a large drainage tube through the urethra

into the bladder, irrigation begun at once, the lateral cavities packed each with strips of iodoform gauze (Fig. 362), the levator ani muscles drawn together in front of the rectum with a single suture of

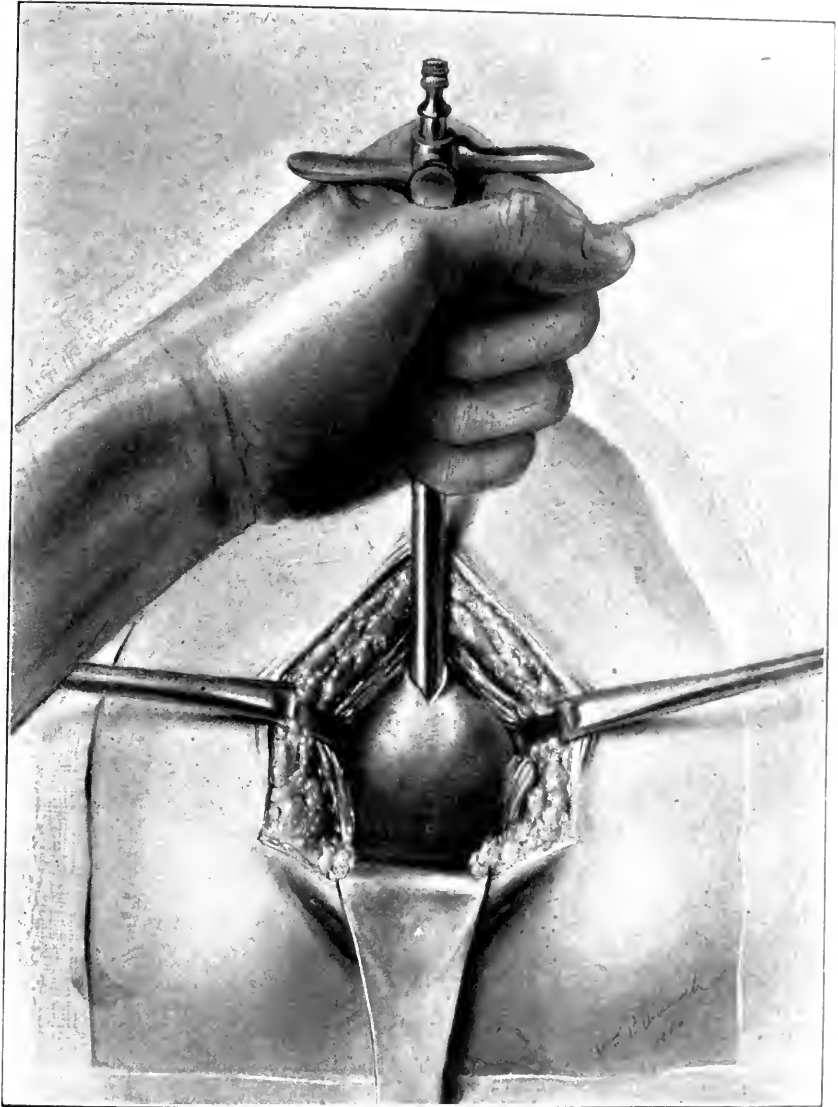


FIG. 358.—Prostate drawn down by tractor, posterior surface freed.

catgut, and the skin approximated on one side by the interrupted sutures of catgut. If the patient is very weak an infusion is often begun at the beginning of the operation, but usually we wait until the return to the ward. From 500 to 800 c.c. are generally given beneath the

breasts. Irrigation, begun on the operating table, is given intermittently in the ward. The patient is given water to drink as soon as possible and an effort is made to make him take as much as he can. The gauze is generally removed on the morning after the operation, and the tubes during the afternoon, when all bleeding following the removal of the gauze has ceased. On the following day the patient is usually put in a wheel-chair and taken outdoors, and, as a rule, the

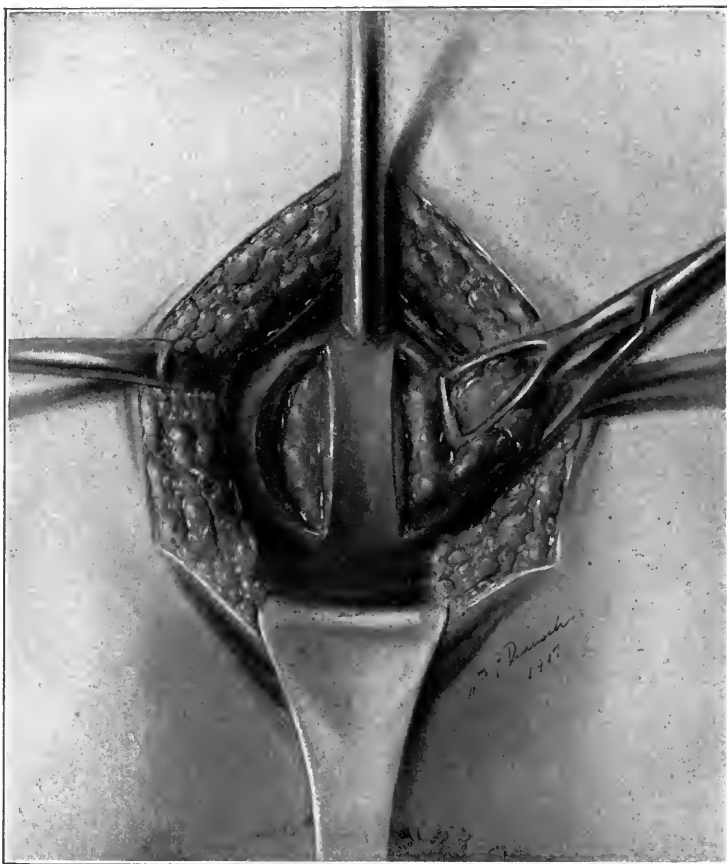


FIG. 359.—Incision of capsule and enucleation of lateral lobes.

convalescence is as rapid as we see after perineal prostatectomy for benign hypertrophy. In fact, owing to the small size of the cavity, the closure of the fistula and restoration of normal urination are usually somewhat quicker, as shown by reference to the detailed report elsewhere of cases treated by perineal prostatectomy.

*Results* of conservative perineal prostatectomy in 71 consecutive cases of cancer of the prostate. There were four deaths, none immediately following the operation, the earliest being twenty-three days after

operation for uremia, and the others twenty-six, thirty-six, and forty-nine days after operation. All of these were desperate cases, suffering greatly, operation being performed in hope of relief, and having little to do with the fatal ending. The mortality of 5.6 per cent. is therefore not just to the operation. The results obtained have been analyzed and tabulated as follows:

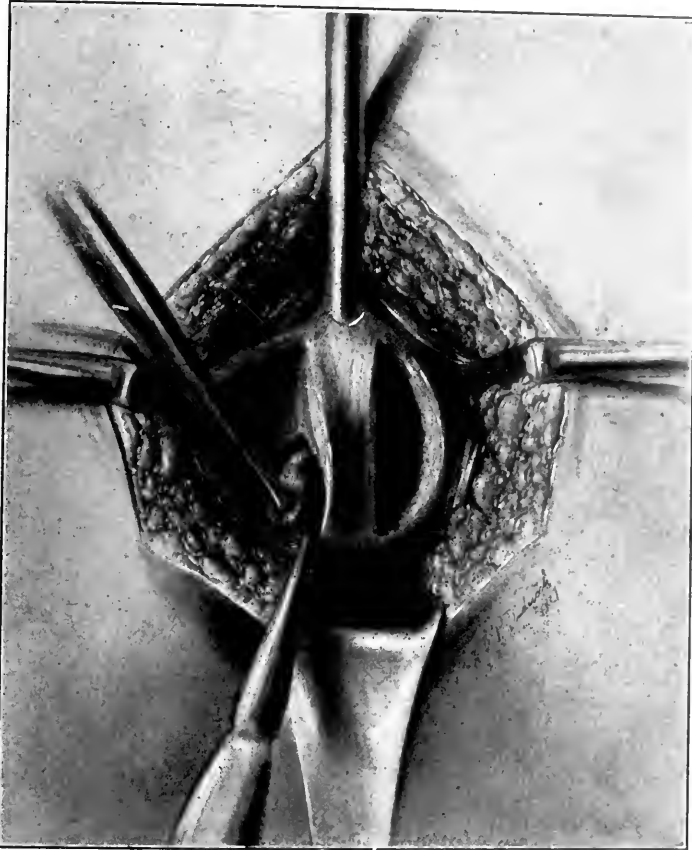


FIG. 360.—Excision of infiltrated median bar.

*A. Good Result as Long as Patient Lived, Twenty-four Cases.*—In these cases the operation was entirely successful in removing the obstruction permanently. The duration of life was over four years, 1 case; over three years, 3 cases; over two years, 5 cases; over one year, 4 cases; six to twelve months, 5 cases; under six months, 6 cases.

Many of these cases were remarkable not only in being completely free from urinary obstruction, but also in being otherwise comfortable almost up to the end. In 4 cases there was some intestinal obstruction due to growth of cancer higher up. In only 3 cases did a small fistula

develop at the site of operation before death, but in no case was there hematuria at any time.

Twelve of the 24 cases are reported to have had no pain up to death. In 7 severe pain, generally in back or thighs, was present. It was present before operation in most of these cases, but there were others not in this group in which severe pain developed later. I think I can safely say, however, that it is not hastened by operation and is often

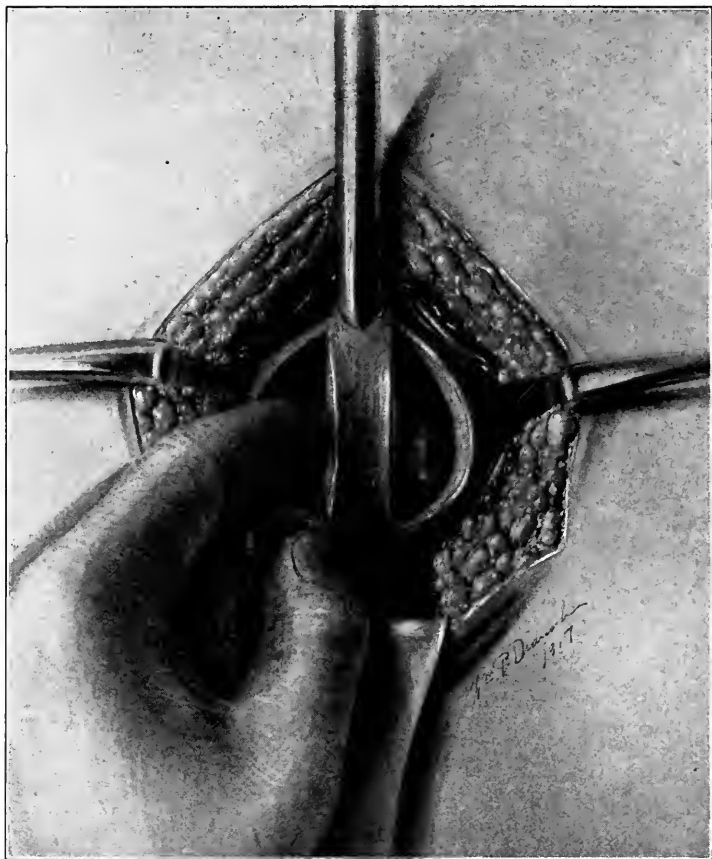


FIG. 361.—Removal of rounded median lobe through the left lateral cavity.

relieved thereby. Fenwick pointed out years ago that in cancer of the prostate, pain would often disappear when the disease broke through the capsule—apparently thus relieving tension.

*B. Patients Still Alive and Entirely Relieved of Obstruction to Urination, Fourteen Cases.*—Twelve of these cases are free from pain. In 3 a pinpoint fistula exists. No hematuria is reported, and none have required catheterization, micturition being fairly normal. The duration since operation is three years, 1 case; over two years, 2; over one year, 5;

between six and twelve months, 2; indefinite, 2. If group B be added to group A we have 38 in 71 cases with excellent operative result, or 53.5 per cent. To this may be added 11 cases in which, although the operative result, removal of obstruction and restoration of free urination has been accomplished, still accompanying conditions, present before operation, have been so severe as to negative the results, *e. g.*, seven patients were terrible sufferers from pain (generally in back and legs) before operation, and this still continued in such severity as to over-

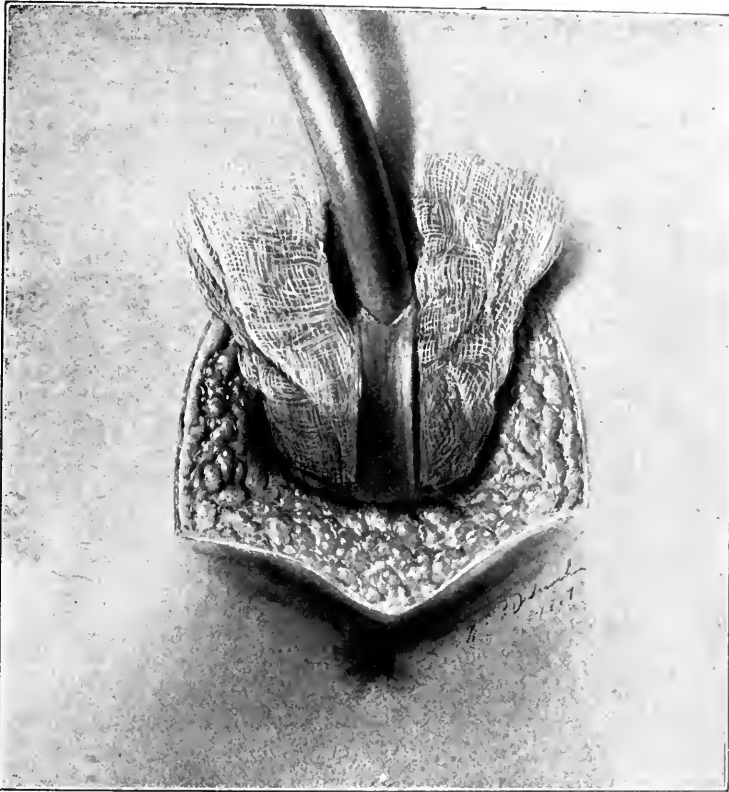


FIG. 362.—Lateral cavities in prostate packed with gauze. Tube drain of bladder through membranous urethra.

shadow everything else. In 2 there was very little residual urine before operation, and the size of the bladder was small. Urination has since been free but frequent. In only 1 case were there hemorrhages. These were all bad cases, 3 lived less than one year, 7 between one and three years, 1 still alive. They represent a class of patients whose sufferings are so intense from pain, and difficulty and frequency of urination are so great, that something is demanded.

The operation, however, relieved the obstruction permanently, and these should therefore be added to the previous groups, thus giving as

results in removing obstruction and giving free urination 49 in 71 cases, or 69 per cent. successful.

C. *Partial Recurrence of Obstruction.*—There were 4 cases (5.6 per cent.) in which the obstruction relieved for a time partially returned within six months in 3 cases and after eighteen months in 1 case. The latter patient lived over four years, the others twenty-two, ten, and four months respectively. None of these 4 patients returned to the catheter life, and all were undoubtedly improved by operation.

D. *Complete Recurrence of Obstruction.*—This class comprises 11 cases in which recurrence of obstruction was sufficient to require catheterization in 5 cases (7 per cent.), a Bottini operation in 1 case, suprapubic drainage in 4 cases (5.6 per cent.), suprapubic prostatectomy in 1 case.

In 4 of these cases the obstruction returned within six months after operation, in 2 within a year, in 2 over two years later, in 1 over three years later. These cases may therefore be set down as failures, 16.6 per cent., although a definite period of freedom from obstruction was afforded. Three patients lived one year, 5 over two years. In 8 of these 11 recurrent obstruction cases, hypertrophy was present (74 per cent.), and one patient was subsequently relieved of the obstruction by suprapubic enucleation of two large adenomatous lateral lobes, normal urination being restored. In this case the cancer lay entirely in the posterior part of the prostate and seminal vesicles. Freyer has reported similar cases in which the demarcation was so sharp that suprapubic enucleation could easily be carried out successfully.

The patients in this group were happily free from pain in all but 2 cases.

Careful review of the operative notes fails to reveal any reason for the recurrence of obstruction in these 11 cases—apparently the removal was just as completely successful as in the other cases which remained free from obstruction. Perhaps it is surprising that in more cases this frankly partial operation is not temporary in its results.

E. *Complete Radical Cures, Two Cases.*—These 2 cases were accidental cures. The cancer in each case was only a small nodule, not recognized until after operation, but removed with a sufficiently wide margin of healthy tissue, so that a complete cure has been obtained. Both patients are alive and well now, seven and a half years in 1 case and eleven years in the other.

These cases may be used as an argument for early perineal prostatectomy.

*General Remarks.*—The foregoing study of 71 patients with cancer of the prostate in which 69 per cent. were permanently relieved of obstruction to urination demonstrates fully, I believe, the great value of perineal prostatectomy, where care is taken to remove the cancerous lateral and median lobes, and any adenomatous hypertrophy which may coexist, as it has been shown to do in 61 per cent. of the cases. Special care should be taken to see that the vesical orifice, which is often contracted, is well dilated and that no small spheroids of hypertrophied

tissue remain, as these have probably caused the recurrence of obstruction in several of my cases. To recapitulate: We have in 71 cases treated by conservative perineal prostatectomy, complete cures, 3 per cent.; permanently successful removal of obstruction, 69 per cent.; partial recurrence of obstruction, 5.6 per cent.; recurrence of complete obstruction, 16.6 per cent.; deaths in hospital, 5.6 per cent.—the earliest twenty-three days—and no deaths strictly attributable to operation.

IV. *Suprapubic Prostatectomy, Two Cases.*—The prostate was enucleated in 2 cases, in both of which the malignant nature of the disease was not recognized. One of these was operated upon in 1898 by another surgeon and resulted in death thirty hours after the operation. Autopsy showed numerous pelvic metastases. In the second case I failed to recognize the malignant nature of the disease and performed a suprapubic prostatectomy after removing a very large vesical calculus. It was impossible to separate the prostatic lobes from the urethra, and the entire prostate was shelled out in one mass along with the urethra. The patient returned five years later complaining of a tumor of the kidney. He reported that there was no difficulty or frequency of urination and that the operation had cured him completely. Rectal examination, however, showed a large indurated mass in the region of the prostate, and seminal vesicles, and study of the microscopic sections of the prostate removed at operation showed carcinoma, thus explaining the nature of the supposed kidney tumor. The patient died a few months later. The prostatic enlargement in this case was largely due to adenomatous hypertrophy. This probably accounts for the ease with which it was shelled out suprapubically. In cases in which there is no hypertrophy present, but the prostate is of the small, hard variety, as seen in many of our cases, it would seem almost impossible even to start the enucleation through the bladder and that for such cases a suprapubic prostatectomy is out of the question. Freyer agrees to this. The fact that the urethra comes away with the prostate in these cases is, I believe, a distinct objection to the suprapubic route even when the presence of intravesical adenomatous lobes makes it possible, as the cavity may fill up with a fungating carcinomatous growth.

It seems advisable here to refer to recent papers by Freyer and by Judd.

In the *Lancet* for December 13, 1913, Freyer gives his statistics in regard to cancer. He says he has seen 171 cases of cancer to 1105 of hypertrophy, or 13.4 per cent. of all cases were cancer. He does not give the number of these cancer cases which were operated upon, nor has he had complete pathological studies made of all the prostatectomy specimens to see how many contain cancer. He details, however, 10 cases in which suprapubic prostatectomy was successfully carried out, the entire prostate, with the urethra, anterior commissure, and "true capsule," being removed in one piece. That this procedure may be radically successful in certain early cases in which the cancer is not too close to the capsule, and still confined within the substance of the prostate, is quite admissible, and this is borne out by the fact that in

5 of Freyer's 10 cases the patients have been well now from six to ten years since operation.

Freyer does not recommend the procedure as a radical operation, and remarks: "I could give details of other cases in which the results were not so satisfactory, the disease recurring and leading eventually to contraction of the urethra," etc.

One of my cases (mentioned above) operated as early as 1901 and published in 1909 demonstrated that it is possible occasionally to get a good functional result for over five years—death finally supervening from cancer—but such are rare, and the general consensus of opinion is that cancers of the prostate should not be attacked suprapubically.

In Judd's paper before the Southern Surgical and Gynecological Association, 1914, he reports among 878 specimens removed by prostatectomy 93 containing cancer were studied microscopically. Seventy-five per cent. showed a coexistent hypertrophy, and he confirms our discovery that in such cases "the malignant process always started in the posterior lobe, and was often distinctly separated from the rest of the gland which was not involved."

He has heard from 82 of the 93 patients, but gives no figures as to the number of successful cases, simply remarking that "many of the patients living at the present time are entirely free from symptoms." "In the cases of recurrence, hematuria was one of the first evidences of the recurrence. Difficulty of urination was an early symptom and became rapidly marked, necessitating suprapubic cystotomy in a number of cases. Several lived three years without trouble, when there was a return of all symptoms." "One patient living nine years had a small carcinomatous nodule removed." "Twenty-four died within the first six months."

*V. Bottini Electrocautery Operation, Eight Cases.*—The Bottini operation was employed to relieve prostatic obstruction in 7 cases. In 4 of these cases the diagnosis of carcinoma was made, and the operation employed simply as a palliative procedure with distinct improvement in all 4 of them.

In 3 cases the malignant nature of the enlargement was not recognized, and the Bottini operation was employed, as I was using it to the exclusion of other methods at that time. The results obtained were very good in all 3 cases. In 1 case the obstruction recurred, and the patient died within a year. In the second case the result was excellent for sixteen months when symptoms of obstruction again appeared, and suprapubic cystotomy for drainage had to be employed three years after the Bottini operation. The last case has been remarkable for the immense benefit conferred by the Bottini operation. For almost six years after the Bottini operation the patient lived free from pain and discomfort, although the prostate and seminal vesicles were markedly involved, and general glandular metastases were present. A review of these seven cases shows several remarkably good results with the Bottini operation, but, as a whole, perineal prostatectomy is the preferable operation where it is desired to relieve the patient from the

necessity of painful and difficult catheterization, and the discomforts of life with a suprapubic drainage apparatus.

VI. *Castration, Two Cases.*—Castration was performed for the relief of prostatic obstruction in 2 cases fifteen years ago. In 1 case the operator did not recognize that the disease was carcinomatous, and performed castration, which was then in vogue, in order to produce an atrophy of the enlarged prostate. Suprapubic cystotomy for drainage was provided at the same time. The result was negative, and the patient wore a suprapubic drainage apparatus until his death a year or so later.

In the second case, which was operated by the writer, the diagnosis of carcinoma was evident. There was no frequency or difficulty of urination, but the patient complained of severe pain in the rectum, buttocks and limbs. No operation to relieve obstruction was indicated, and castration was performed with the hope that some change in the prostate, which might bring about relief of the rectal pain, might follow. The result, however, was negative.

VII. *Suprapubic Drainage, Twelve Cases.*—In all these cases the catheter was tried first, and the operation performed either because it was impossible to introduce the catheter or its use was so painful or difficult that catheter life could not be endured. In several cases the patient employed the catheter for a long period before finally demanding operative relief. In nearly all of these cases the disease was far advanced and the condition often desperate. One patient died a week after the operation, one lived only a month, another only five months, and a third six months. In these 3 cases the patients suffered very greatly and the operation afforded very little relief. In 2 cases it has been impossible to find the patients since their departure from the hospital. In 6 cases the drainage apparatus was employed, and in 5 cases all reports state that it worked well; there was no leakage around the tube, the patients were able to empty the bladder at fairly long intervals by opening the stop-cock, and there was very little pain or vesical discomfort.

As noted above, the results obtained by suprapubic drainage were distinctly better when an apparatus was provided by which the bladder would be emptied only at stated intervals rather than being allowed to drain continuously.

VIII. *Perineal Drainage, Two Cases.*—In 2 cases perineal urethrotomy had been performed, in 1 case on account of abscess of the prostate involving the perineum, and in the second case on account of the inability of the patient's physician to pass a catheter, complete retention of urine being present. Except in suppurative conditions perineal urethrotomy has little to commend it.

IX. *Cases Treated by Catheterization.*—There were 39 cases in which the patient was advised to lead a catheter life and no operation was attempted. In nearly all these cases the disease was too far advanced for a radical operation, but in many of the cases conservative perineal prostatectomy might have been performed with considerable relief. In

order to compare the results obtained by the use of the catheter with those of prostatectomy we have attempted to get an accurate idea of the subsequent course of the cases.

It has been impossible to get an accurate reply in all cases as to the progress of catheter life. In 2 cases subsequent operations were required. Suprapubic cystotomy 1, perineal prostatectomy 1. In 10 cases the catheter life was said to be painful, difficult, or very obnoxious, and often the catheter had to be used very frequently. In only 8 cases was the catheter life said to have been satisfactory and in 2 of these the patient said it was quite disagreeable. In other cases no reply could be obtained. Final notes have been received in regard to 28 patients. Five are still alive two years, ten months, six months, five months, and five months since admission, and in these cases the disease has been present five years, two years, two years, six years, and four years.

Twenty-three patients are dead, the length of time they lived after being seen by us being a month or less 6 cases, under six months 3 cases, under a year 6 cases, over a year 6 cases, two years 1 case, five years 1 case.

As seen in this tabulation of 23 cases only 3 patients have lived two years or more since their first visit, so that it would seem that the duration of life after perineal prostatectomy was, as a rule, longer than with a catheter life.

X. *Cases in which Neither Operation nor Catheter Life was Advised.*—There were 29 which came in this category. These cases present an unusual and interesting group because of the lack of the usual severe obstruction to urination. In 19 cases a catheter had never been used, in 4 cases it had been only occasionally employed. In 1 case acute retention of urine was present on admission and in 4 cases the catheter was employed daily. In 8 cases the difficulty of urination was considerable, in 2 cases slight; the increased frequency was considerable in 11 cases, moderate in 4, and slight in 7 cases. Pain was the most prominent symptom in most cases and involved various regions from the chest to the feet. The duration of symptoms of the disease was less than one year in 7 cases, two to three years in 14 cases, and over three years in 7 cases.

The prostate and seminal vesicles were considerably enlarged in 50 per cent. of the cases, so the lack of urinary obstruction was not due to the absence of prostatic enlargement. Among the 21 patients from whom replies have been obtained in only 5 did catheterization become necessary, and in 3 of these subsequent operations were necessary (two suprapubic drainage and one perineal prostatectomy with relief from catheter life). Among the 21 patients that have been heard from, 7 are still alive, 3 of them six months, 3 between six and eleven months, and 1 one year after being seen by us. In these 7 cases the patients have lived five, four, three, and two years, nine, nine, and seven months since the beginning of symptoms. Fourteen patients have died since our examination, having lived less than six months, 4 cases; between six and eleven months, 2 cases; one year, 1 case; two years, 5 cases; and three

years, 2 cases. The total length of time these patients lived after beginning of symptoms was under six months 1, under one year 1, over one year 1, two years 4, three years 3, four years 1, five years 1, eight years 1, ten years 1.

This class of cases therefore is remarkable for the extent of the involvement and the freedom from marked urinary obstruction for long periods. They represent a class in which early diagnosis is difficult unless rectal examination be made before the beginning of obstructive symptoms and for merely slight pain and discomfort in various regions from the chest down (which are shown to be reflexly involved by carcinoma of the prostate). The presence of an indurated prostate in any such case should lead to careful investigation and probably exploratory operation. These cases show the great importance of rectal examinations as a routine in physical examinations.

### THE USE OF RADIUM IN CANCER OF THE PROSTATE.

Pasteau and Degrais have contributed several important articles on the use of radium in cancer of the prostate. They made use of from 20 to 50 mgs. of radium, screened by a thin capsule of silver and by the gum coudé catheter, in which it was placed by means of a stylet. A No. 17 catheter was used, being large enough to let the escape of urine around the capsule containing radium, thus allowing the use of radium in the prostatic urethra for several hours.

Their first patient with inoperable cancer of the prostate and adjacent portion of the bladder (hard, nodular, fixed prostate, irregular cancer of middle lobe) had 29 séances of radium treatment (20 to 50 mgs. at a time and usually for two hours at a time). He had three treatments in October, 1909, 13 in the next eight months, 7 in the year 1911, and 4 in 1912. As early as February, 1910, the tumor had apparently disappeared, and numerous examinations since (the last being July, 1913) failed to show a return—the prostate being soft, small, mobile, and the bladder negative. On last report the cure had been maintained almost four years. Another case was that of a man seen in 1909 with a hard, nodular, fixed prostate, the cancer extending into the region of one seminal vesicle. Series of radium applications were made in July and August, 1909, with a tube of 50 mgs. remaining in place for two hours, the applications being repeated in September and October. In February, 1910, marked improvement was found, and under the influence of renewed application of the rays by the end of 1910 one-half of the prostate was much softer. Series of treatments—three or four two-hour exposures during the course of a month constituted a series—were continued for two years, and at the time of reporting “three years after the commencement of the treatment the extension has been arrested and the patient has improved greatly in health.”

In another case eight séances of three hours each with 40 mgs. of radium caused marked shrinkage and softening of the prostate. Pasteau remarks that they have observed 3 patients in all of whom, when

they came under observation, the prostate was enlarged, nodular, and very hard, in whom now the prostate is soft, not adherent, and does not at all resemble cancer. Each of these had only one series of radium applications, yet they are reported as remarkably benefited if not cured.

I have tried the urethral catheter method of Pasteau with some success, but have found it inaccurate and unsatisfactory. I accordingly devised (in 1914) radium-carrying instruments of metal, which are capable of being used with a cystoscope, which permits of accurate application of the radium in the bladder and at the vesical orifice. I have also introduced the use of the rectal route for applications upon the prostate and seminal vesicles. After a long series of experiments and treatments I have shown that a great many treatments can be made through the rectum, urethra, or bladder if a new place is selected each time—the sites of the treatments do not overlap. The results have been a remarkable series of cases in many of which the cancerous infiltration of prostate and vesicles have apparently disappeared—a marvelous change—I do not dare to call them cures.

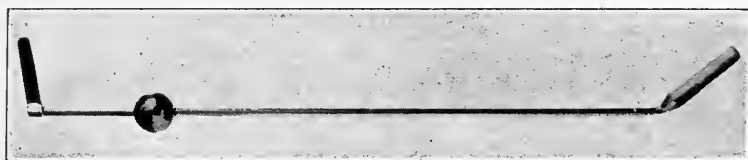


FIG. 363.—Simplest rectal carrier.

Perhaps these new methods may be best illustrated by a case—a very advanced one, with cancer of prostate and both seminal vesicles, as shown in chart. With my simplest rectal radium-carrier (Fig. 363) applications were made, with the guidance of a gloved finger in rectum, to various sites along the carcinomatous mass in vesicles and prostate, as shown by the chart (Fig. 364). The exact position desired is maintained by a mechanical arm and clamp attached to the table (Fig. 365). The dates of each treatment and “milligram hours” are given on the chart. The patient also received urethral and intravesical treatments shown in the second chart, instruments shown in Fig. 365 being used. In the case of the latter instrument a cystoscope is used and one can thus direct the exact application in the bladder so as to radiate a seminal vesicle, infiltrated trigone, or an intravesical outgrowth of the carcinoma, as shown in Fig. 366. The method employed in certain vesical tumors is the same. The results obtained in this case have been a complete disappearance of all induration and enlargement, both in prostate and seminal vesicles; 2125 mg. hours per rectum and 3125 mg. hours, per urethram et vesicam, were used. Irritation but no burn resulted, and normal urination was largely restored.

I have now used radium in over thirty cases of prostatic cancer in the past two years, and while it is much too early to speak of permanent results, there is no question that really wonderful changes, often a com-

plete disappearance of the tumor mass, have been brought about in the majority of cases. In some cases obstruction to urination has persisted, and in four cases conservative perineal prostatectomy has been

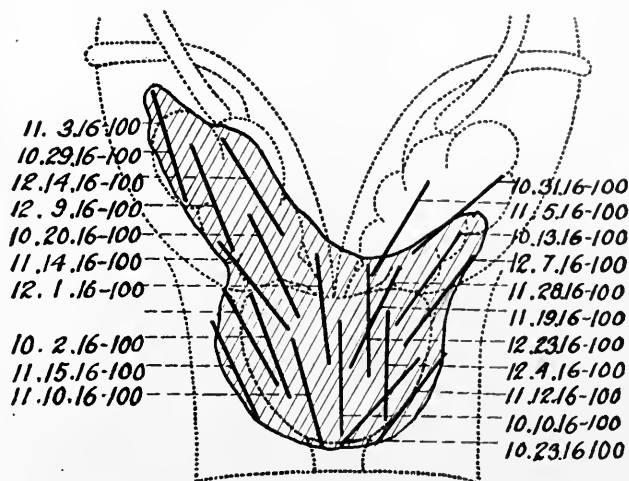


FIG. 364.—Rectal chart showing application of radium to prostate and seminal vesicles.

carried out with success. In these operations a replacement of the cancer by fibrous tissue has been found, and what cells remained have often shown great changes in nucleus, vacuolization, or disappearance,

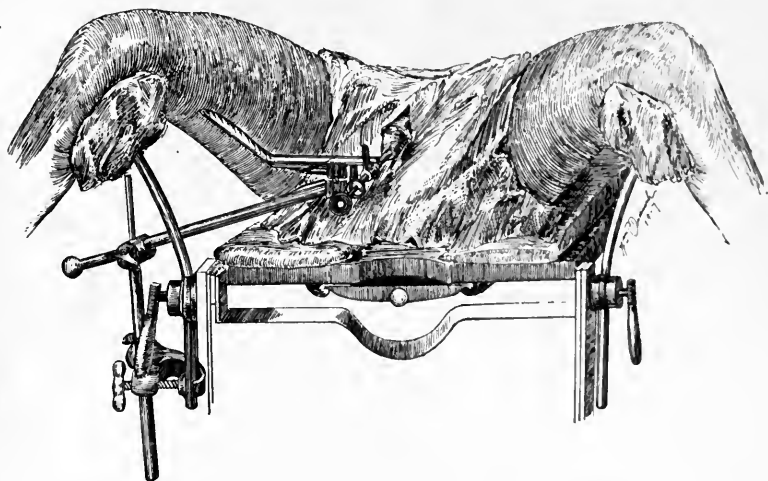


FIG. 365.—Mechanical arm and clamp attached to table to hold radium in position.

and pronounced colloid degeneration of the epithelium. In one case a "Punch" operation was successful in removing the obstruction, after prolonged radiation had caused a disappearance of the enlargement—

leaving only a fibrous, contracted prostatic orifice. I have used the *x*-rays and radium externally, in large doses, in certain cases, particularly those with nerve involvement.

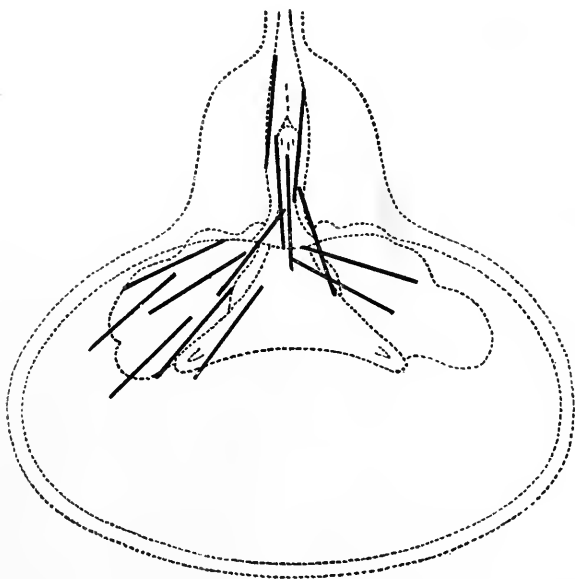


FIG. 366.—Urethral and bladder chart.

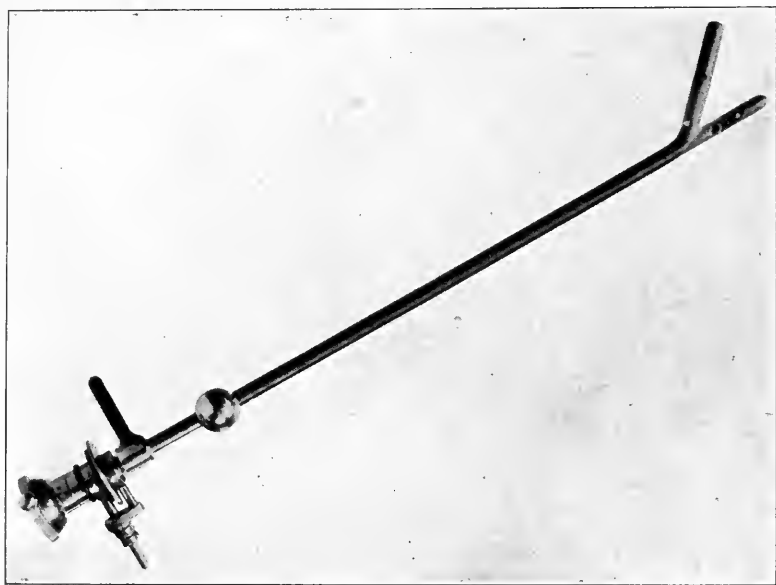


FIG. 367.—Author's cystoscopic radium instrument, No. 1.

The method of puncture with emanation-carrying needles, as carried out recently by Janeway and Barringer, is very greatly limited, and I believe less generally efficacious. It seems probable, therefore, that we are on the verge of great results with radium in the treatment of

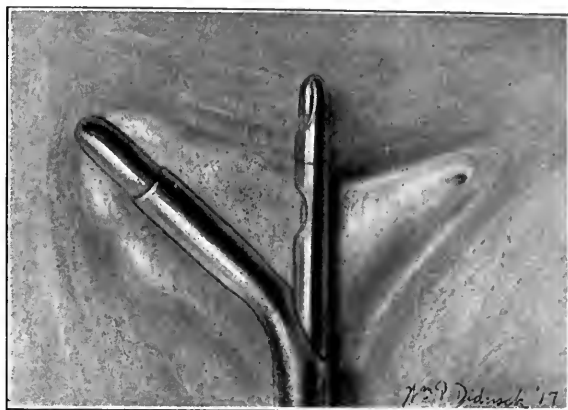


FIG. 368.—Showing use of radium in bladder with cystoscope on tumor of trigone

cancer of the prostate and vesicles. The accurate methods of application and of charting, above detailed, have greatly increased the value of urethral and vesical treatments, and also opened up the rectal route as a most effective approach to the prostate and vesicles.

## CHAPTER XXI.

### SARCOMA OF THE PROSTATE.

By HUGH HAMPTON YOUNG, M.D.

THE first case of sarcoma of the prostate was described by Stafford in 1839, a melanotic tumor in a child five years of age. In 1858 Thompson found 6 cases in the literature, and in 1902 Burckhardt was able to collect 24 cases. Proust and Vian, in 1907, published 34 "incontestable" cases. I now add one case from my practice.

*Age.*—In the 35 cases in which the diagnosis has been confirmed by the microscope, 15 were under ten years of age; 12 were between ten and forty-nine years of age, and 8 were between fifty and eighty years of age. In 4 cases the patient was less than a year old and three patients were between seventy and seventy-three years of age.

Various types of sarcoma have been present, viz., small cell, 6; large cell, 3; spindle cell, 5; polymorpho cell, 4; lymphosarcoma, 2; angiosarcoma, 2; myxosarcoma, 3; adenosarcoma, 1; chondrosarcoma, 1; "rhabdomyoma," 3; "fibroid," 1.

The tumor soon reached considerable size and in some places almost completely filled the pelvis. It was usually oval in form, regular or slightly lobulated, but occasionally irregular and nodular. The consistence was variable, sometimes firm, sometimes elastic, sometimes so soft as to give the sensation of fluctuation. In many cases, however, the induration was considerable. The bladder was generally pushed upward and forward by the tumor, which grew backward beneath the base of the bladder. The mucous membrane was generally intact, but occasionally small papillomatous intravesical outgrowths were present, almost always in the region of the trigone. The rectum was usually compressed, flattened, but its walls were rarely infiltrated and the mucous membrane was healthy in all cases. The urethra was almost always invaded and generally strictured. Occasionally intra-urethral polyps were present. The seminal vesicles have generally been found involved. The perirectal and retroperitoneal tissues were often invaded, as were also the peritoneum, the intestines and the pelvic bones. The lymph glands were involved in 7 of the 35 cases, but metastases elsewhere occurred more frequently.

That sarcoma of the prostate is a rare disease is shown by the fact that only 1 case has been detected among the immense number of cases seen at the Hôpital Necker in Paris. I have personally had 1 case in which the diagnosis of sarcoma of the prostate was positively made by microscopic examination, but in our service there have been 2 cases in which a clinical diagnosis of sarcoma has been made. My patient, a

man, aged fifty-one years, had suffered with pain in the lower abdomen and rectum for fourteen months. Urinary trouble had been present for six months, but had only recently become marked. On rectal examination an immense smooth mass, which almost filled the pelvis, was felt. It was very soft and homogeneous to the touch and almost completely obliterated the rectum. Only 40 c.c. residual urine was present. Perineal prostatectomy was performed and the tumor found to spring from the upper portion of the prostate, the anterior two-thirds of which was apparently normal. The urethra and bladder were not invaded, but the latter was greatly elevated by the huge retrovesical mass. The tumor was composed of soft hemorrhagic material which was easily scooped out with the finger. The patient recovered and was able to void urine without difficulty and lived for almost a year. The microscope showed a sarcoma of mixed-cell type.

**Symptoms.**—Proust has divided his study into those of early age, 24 cases, and those of advanced age, 10 cases. Among these of early age the first symptom was usually pain, and this did not come on until obstruction to urination developed. Constipation was often present. In most cases the tumor had reached great size before any symptoms were present. Among those patients older than thirty years of age the development was slower. In rare cases sudden retention of urine occurred, but often there was very little obstruction to either urine or feces. At times, owing to its softness, it is difficult to differentiate from abscess. In the adult, sarcoma of the prostate is generally more irregular than hypertrophy, produces less lengthening of the canal and is more infiltrated. Sarcoma is less often accompanied by hematuria than carcinoma, which is usually much harder and characterized by indurated prolongations into the region of the seminal vesicles. In my case the consistence was much softer than is ever seen in simple hypertrophy, and the immense, smooth, globular mass could never have been mistaken for carcinoma.

**Treatment.**—In young patients operations have been absolutely unsuccessful. In the adult the results have not been brilliant, but several cases in which the patient was relieved for a considerable period are on record. Spanton, in 1882, enucleated through the perineum a very large sarcoma of the prostate, but the patient died on the following day. In 1894 Socin removed a tumor the size of two fists through the anus and rectum, without injury of the urethra or bladder. The rectum was then sutured. The patient showed no evidence of recurrence for three years. Verhoogen, in 1898, extirpated the prostate with its capsule and urethra after division of the membranous urethra. The patient died later of a recurrence of the sarcoma. McGowan reported a case in which the patient was apparently cured, but died four years later of cancer of the liver. A patient of Fuller's lived eleven months.

In my case it was impossible to perform radical excision, and I could only scoop the broken-down material within the capsule. The obstruction to urination was removed, but the patient died one year later.

Owing to the fact that sarcoma of the prostate generally begins in the upper portion of the posterior part of the gland and rapidly involves the capsule and retrovesical structures, it seems probable that radical measures can never be as successful as in cancer. Sarcoma may remain encapsulated, as in Socin's case, and a complete extirpation through the perineum may be possible. The suprapubic route will probably not be available, owing to the retrovesical character of the growth. Suprapubic drainage may be necessary in some cases.

## CHAPTER XXII.

### CALCULUS DISEASE OF THE PROSTATE.

By HUGH HAMPTON YOUNG, M.D.

PROSTATIC calculi may be divided into two groups, on account of their origin and location: (1) Calculi which lodge in the prostatic urethra, having escaped from the kidney, bladder, or seminal vesicles, and the small group of cases in which the stone is primarily formed in the posterior urethra. (2) Calculi which are formed in the substance of the prostate gland, the true prostatic calculi. This second group is entirely distinct in origin and nature from the urinary calculi.

On account of the intimate relation existing between corpora amylacea and prostatic calculi, it is necessary to consider the former before taking up the subject of true prostatic stones.

**Etiology.**—This is uncertain, as is the case with calculi elsewhere. Various authors have ascribed to corpora amylacea a causative influence. According to Thompson, corpora amylacea, having attained the size of their inclosing follicle, act as foreign bodies, and in consequence of the general law that all mucous membranes when sufficiently irritated throw out a deposit of calcium phosphate and carbonate, ultimately form calculi. The amount of earthy matter varies from 45 per cent. in the concretion to 85 per cent. in the calculus. The number of calculi present may vary from one to several hundred. They are generally a little less than that of a barley-seed in diameter, but they may range in size from 2 mm. to 3 or 4 cm.

**Symptoms.**—Stones deeply embedded in the gland cause, as a rule but slight disturbance, and the gland may be filled with stones and yet no marked symptoms occur. Irritability of the bladder and pain are sometimes present. Frequency or hesitancy of urination is seen oftener than initial or terminal hematuria, the latter being much more constant and characteristic in the case of vesical stone. Retention or incontinence occurs especially if stones are located in the middle lobe. Occasionally the genital symptoms are marked; testicular pain, frequent ejaculations, feeble erections and a condition of semipriapism having been noted in different cases. Rectal palpation in the early stages may disclose an enlarged but not indurated gland. When the calculi are not near the posterior surface, the gland is smooth and regular; as the stones approach the periphery it becomes irregular and the hardness may be very marked. When two or more stones are in contact, crepitus may be elicited. It may be absent, however, even when a great many stones are present. When the stone is in communication with the urethra, a sound will give crepitus, and considerable additional

advantage is obtained by the simultaneous rectal palpation with the finger. If a rectal or perineal fistula exists, the passage of a probe through it frequently leads to the stone. With the cystoscope or the urethroscope the calculus can sometimes be seen and the *x*-ray has been used with considerable advantage.

The complications occasioned by prostatic stone are, briefly: abscess, fistula, prostatic hypertrophy, incontinence or retention of urine, sexual disorders, including deferentitis and epididymitis.

**Treatment.**—When the stone communicates with the prostatic urethra, it may be removed through the bladder by suprapubic cystotomy. In cases where the stone is more or less completely embedded in the prostatic substance the suprapubic route is contra-indicated. The perineal route is preferable in most cases. The prostate should be exposed as for a perineal prostatectomy, and opened either upon a grooved staff or upon a prostatic tractor which has previously been inserted. In young patients the calculi are usually not great in number and it is not necessary to remove gland tissue. The multiple seed calculi which are found scattered throughout the gland are almost always associated with prostatic hypertrophy or obstructive prostatitis, and prostatectomy is indicated, being the simplest way of removing the calculi.

# INDEX.

## A

- ABNORMALITIES** of scrotum, 449  
**Abscess**, peri-urethral, anterior gonorrheal urethritis and, 304  
 stricture of female urethra and, 364  
 prostatic, acute posterior gonorrheal urethritis and, 306  
 gonorrheal stricture of urethra and, 392  
 of scrotum, 452  
 suburethral, acute gonorrheal urethritis in female and, 379  
**Absence** of penis, 201  
 of urethra in female, 349  
**Actinomycosis** of penis, 236  
**Adenitis**, inguinal, 283. *See* Inguinal Adenitis.  
**Adenocarcinoma** of scrotum, 460  
**Adherent** penis, 202  
**Alexander**, Samuel, historical sketch of, 31  
**Amplification** of field in direct optical system, 58  
**Andrew's** "bottle" operation for hydrocele, 471  
**Anesthesia** in cystoscopy, 70  
 in gonorrheal stricture of urethra, 394, 398  
**Anorchism**, 430  
**Antigenococcus** serum in treatment of gonorrheal urethritis, 327  
**Aspiration** in treatment of hydrocele, 470  
**Atrophic** phimosis, 224  
**Atrophy** of testicle, 430  
**Autoserotherapy** in treatment of hydrocele, 468

## B

- BALANITIS**, 230  
 erosive and gangrenous, 264  
 bacteriology of, 264  
 chills in, 269  
 definition of, 264  
 diagnosis of, 269  
 edema in, 269  
 etiology of, 264, 266  
 fever in, 269  
 pathology of, 266  
 symptoms of, 268  
 treatment of, 270

- Balanoposthitis**, acute anterior gonorrheal urethritis and, 305  
 in inflammation of penis, 231  
 phimosis and, 224  
**Beck's** operation for epispadias, 213  
 for glandular hypospadias, 204  
 for scrotal hypospadias, 208  
**Bigelow**, Henry J., historical sketch of, 24  
**Bigelow's** evacuating apparatus, 40, 41  
 lithotrite, 40, 41  
**Bladder**, calculus of, diagnosis of, from obstruction of prostate, 590  
 cancer of prostate and, 680  
 diseases of, symptoms of, 142  
 diverticula of, pyelography and, 160  
 examination of, instrumental, 119  
 cystoscopy in, 119  
 in genital tuberculosis, 521  
 gonococcal infection of, 334  
 obstruction of, causes of, 139  
 diagnosis of, 140  
 resection of, transperitoneal partial, historical sketch of, 43  
 speculum, Watson's, 56  
 stone in, pyelography and, 160  
 surgery of, historical sketch of, 39  
 syphilis of, 169  
 pathology of, 181  
 secondary, 173  
 age in, 181  
 cystoscopy in, 181  
 tertiary, 175  
 age in, 182  
 cystoscopy in, 182  
 diagnosis of, 182  
 hematuria in, 182  
 pain in, 182  
 pollakiuria in, 182  
 spinal-cord affections simulating, 184  
 symptoms of, 182  
 treatment of, 183  
 tumors of, diagnosis of, from obstruction of prostate, 589  
 operations for, historical sketch of, 43  
**Bevan's** operation for undescended testicle, 438-441  
**Bottini** electrocautery operation in cancer of prostate, 712  
**Bougie** catheter, 582

- Bougie in gonorrheal stricture of urethra, 395, 398  
 Brown's catheterizing cystoscope, 63  
 Bryson, John P., historical sketch of, 30  
 Bubo, inguinal, 283. *See* Inguinal Adenitis.  
 Buerger's catheterizing cystoscope, 66  
   combination operating cystoscope, 86  
   cysto-urethroscope, 96, 97, 348  
   operating cystoscope, 85  
     cysto-urethroscope, 105  
   prismatic cystoscope, 65  
 Burns of penis, 229
- C**
- CABOT, ARTHUR T., historical sketch of, 29  
 Cabot's operation of resection of urethra in gonorrheal stricture, 411  
   tampon, 55  
 Calculi, prostatic, pyelography and, 159  
   removal of, operative cystoscopy and, 90  
   of scrotum, 454  
   ureteral, descent of, operative cystoscopy and, 90  
     diagnosis of, operative cystoscopy and, 88  
     pyelography and, 159  
 Calculus of bladder, diagnosis of, from obstruction of prostate, 590  
   disease of prostate, 723  
   of urethra in female, 356  
   vesical, operations for, historical sketch of, 39  
 Cancer of prostate, 657. *See* Prostate, cancer of.  
 Carcinoma of penis, 237. *See* Penis, carcinoma of  
   of prostate, 657. *See* Prostate, cancer of.  
   of scrotum, 460  
   stricture of urethra and, 416  
   of urethra in female, 362  
 Cardiovascular examination, diagnosis of lesions of urinary tract and, 136  
 Cartilaginous and bony formations of penis, 234  
 Caruncle of urethra in female, 358  
 Castration in cancer of prostate, 713  
 Catarrhal prostatitis, pathology of, 300  
 Catheter-trauma of urethra in female, 353  
 Catheterization in cancer of prostate, 713  
   ureteral, 79, 122  
     cystoscope in, direct, 83  
     Elsner-Braasch, 84  
     indirect, 79  
     operative, 89  
   endoscope in, Kelly's, 84  
     Kelly-Pawlik, 85  
     Luy's, 85  
   Catheterization, ureteral, lack of drainage after, 123  
     obstruction in, 122  
     wax-tip bougies in, 122  
   of urethra in female, 353  
 Catheterizing cystoscopes, 65  
   Brown's, 63  
   Buerger's, 66  
   composite, 68  
   direct, 66  
   Elsner-Braasch, 68  
   indirect, 66  
   Nitze-Albarran, 66  
   universal, 68  
 Catheters, bougie, 582  
   de Pezzer, 615  
     Pilcher modification of, 615  
   Mercier bicoudé, 582  
     coudé, 582  
     soft-rubber, 582  
 Cautery in treatment of caruncle of urethra in female, 359  
 Cavernositis, acute, 233  
   anterior gonorrheal urethritis and, 305  
   etiology of, 233  
   symptoms of, 233  
 chronic, 233  
   etiology of, 234  
 diffuse, 233  
   priapism in, 233  
   pyemia in, 233  
 Cellulitis of scrotum, 452  
 Chafing of scrotum, 450  
 Chancre, 241  
   chancreous erosions, 245  
   ulceration, 245  
   classification of, 244  
   definition of, 241  
   diagnosis of, 247  
     dark-ground illumination in, 247  
     Nernst lamp in, 248  
     Reichert instrument in, 248  
   differential, 255  
   from scabies, 255  
   materials for, obtaining of, 249  
   preparation of, 249  
   Noguchi butyric acid test in, 255  
   Ross-Jones modification of  
     Nonne test in, 255  
   spinal fluid examination in, 254  
   staining methods in, 250  
     Giemsa's, 250, 251  
     Levaditi's, 251, 252  
   Wassermann reaction in, 253  
 endo-urethral, 162  
   discharge in, 162  
   induration in, 162  
   pain in, 162  
   symptoms of, 162  
   etiology of, 241  
   hard, 241  
   histology of, 243

- Chancre, Hunterian, 241  
   incubation in, 244  
   indurated papule, 245  
     Hunterian, 245  
     parchment, 245  
   of meatus, 161  
     symptoms of, 162  
   pain in, 245  
   pathology of, 243  
   prognosis of, 256  
   prophylaxis in, 256  
   soft, 278  
   *Spirochæta pallida* in, 241  
   synonyms of, 241  
   treatment of, 256  
     excision in, 256  
     general, 256  
     local, 256  
     salvarsan in, 256
- Chancroid, 278  
   complications of, 282  
   definition of, 278  
   diagnosis of, 281  
   Ducrey-Unna bacillus and, 279  
   etiology of, 278  
   location of, 281  
   lymphadenitis and, 283  
   lymphangitis and, 283  
   mixed sore in, 281  
   pain in, 281  
   paraphimosis and, 283  
   pathology of, 279  
   phagedena and, 283  
   phimosis and, 282  
   sequelæ of, 283  
   stricture of urethra and, 416  
   symptoms of, 279  
   synonyms of, 278  
   treatment of, 282
- Chimney-sweep's cancer, 459  
 Chondroma of penis, 237  
 Chordee, 303  
 Chylocele, 477  
   diagnosis of, from hydrocele, 467  
   treatment of, 477
- Circumcision and tuberculosis of penis, 235  
 Cleft penis, 202  
 Cloudy urine in diagnosis of lesions of genito-urinary tract, 132  
 Complement-fixation test, 296  
   cases used in, 297  
   in chronic anterior gonorrheal urethritis, 309  
   gonorrheal prostatitis, 311  
   diagnosis of lesions of urinary tract and, 135  
   effect of vaccines in, 297  
   practical value of, 298  
   time of appearance, 297  
   of disappearance, 297  
   weakly positive, 297
- Composite catheterizing cystoscope, 68  
 Concealed penis, 201  
   treatment of, 201
- Concretions in appendix, roentgenology of urinary tract and, 150  
 Condyloma of penis, 237  
 Congenital hydrocele, 475  
   malformations of penis, 198  
   phimosis, 223  
   stricture of urethra in male, 414  
 Corpora cavernosa, anatomy of, 193  
 Corpus Highmori, 422  
   spongiosum, anatomy of, 195  
 Coverings of penis, anatomy of, 196  
 Cowperitis, acute posterior gonorrheal urethritis and, 306  
   pathology of, 300  
 Cowper's glands, anatomy of, 289  
 Cutaneous diseases of scrotum, 450  
 Cylindroid syphiloma of urethra, 165  
 Cystectomy, total, historical sketch of, 44  
 Cystic bodies, operations on, operative cystoscopy and, 91  
 Cystitis, acute gonorrheal urethritis in females and, 378  
 Cystoscopes, 58, 62  
   accessories for, 69  
     lighting apparatus, 69  
     sterilization of, 69  
   catheterizing, 65  
     Buerger's, 66  
     composite, 68  
     direct, 66  
     Elsner-Braasch, 68  
     indirect, 66  
     Nitze-Albarran, 66  
     universal, 68  
   direct, 58, 62  
     Brown's catheterizing, 63  
     Lewis's universal, 63  
   indirect, 65  
     Kelly's, 349  
     Nitze, 60, 62  
   operating, Buerger's, 85  
     combination, 86  
   prismatic, 65  
     Buerger's, 65  
     Otis-Brown-Nitze, 65  
   selection of, 105  
   in ureteral catheterization, direct, 83  
     Elsner-Braasch, 84  
     indirect, 79
- Cystoscopy, anesthesia in, 70  
   in examination of bladder, 119  
     contra-indications to, 120  
     indications for, 120  
   introduction of instrument in, 72  
   lubricants in, 71  
   observation, elementary principles of, 76  
     induced movement of field in, 77  
   light in, 79  
   magnification in, 77  
   problem of sphincter in, 78  
   relation of field and, 76  
   routine in, 73  
   technic of, 72

- Cystoscopy in obstruction of prostate, 584  
     dangers of, 587  
     technic of, 584  
     value of, 586  
 operative, 85  
     catheterization and, 89  
     diagnosis of ureteral calculi by means of wax-tipped catheters and, 88  
     dilating ureters and facilitating descent of ureteral calculi and, 90  
     excision of ulcers and, 91  
     exploratory excision and, 91  
     high-frequency treatment of tumors and, 89  
     intravesical biopsy and, 91  
     methods in, 88  
     operations on cystic bodies and, 91  
     on ureterocele and, 91  
     removal of calculi and, 90  
     of foreign bodies and, 90  
     of phosphatic encrustations and, 90  
     snaring of papillomata and, 91  
     technic of, 88  
     with recessive type of instrument, 88  
     with scissors type of instrument, 88  
     ureteral meatotomy and, 91  
     preparations for, 71  
     solution for, 70  
     suprapubic, in enlargement of prostate, 611  
     in syphilis of bladder, 181, 182  
     syringes in, 71  
     table for, 70  
     ureteral catheters in, 70  
 Cysto-urethrosopes, 95  
     Buerger's, 96, 348  
     Goldschmidt's, 96  
     McCarthy's close vision, 348  
     operating, 104  
     technic and application of, 104  
     selection of, 105  
 Cysto-urethroscopy, technic of, 96  
 Cysts of penis, dermoid, 237  
     epithelial, 236  
     of scrotum, sebaceous, 452  
     of urethra in female, 360
- D**
- DARK-GROUND illumination in diagnosis of chancre, 247  
 Dartos of penis, anatomy of, 196  
     of scrotum, anatomy of, 447  
 de Pezzer catheter, 615  
     Pilcher modification of, 615  
     prostatic tractor, 642  
 Dermoid cysts of penis, 237  
 Diathetic urethritis, 334
- Dilatation in gonorrheal stricture of urethra, 398  
     bulbous, 399  
     dilators in, 399  
     filiforms and followers in, 398  
     instruments required for, 398  
     at meatus, 399  
     membranous, 399  
     pendulous, 399  
     scrotal, 399  
     sounds in, 399  
     technic of, 399  
     woven bougies in, 399  
 Direct cystoscope, 58  
     catheterizing, 66  
     in ureteral catheterization, 83  
 Dislocation of penis, 220  
     of testicle, 442  
 Diverticula of bladder, pyelography and, 160  
 Diverticulum of urethra in female, 366  
 Double penis, 199  
     urethra in female, 350  
 Dropsy in acute parenchymatous syphilitic nephritis, 188  
 Ducrey-Unna bacillus, chaneroid and, 279  
 Ductuli efferentes, 417  
 Ductus epididymidis, 417  
 Duplay's operation for epispadias, 214  
     for glandular hypospadias, 204  
     for penoscrotal hypospadias, 207
- E**
- ECTOPIA of testicle, 432  
 Eczema marginatum of scrotum, 451  
     of scrotum, 450  
 Eczematous urethritis, 334  
 Edema of penis, 230  
     of scrotum, 452  
     of skin in torsion of testicle, 445  
 Elephantiasis of penis, 236  
     of scrotum, filarial, 454  
     non-filarial, 459  
 Elsner-Braasch catheterizing cystoscope, 68  
     cystoscope in ureteral catheterization, 84  
 Emphysema of scrotum, 453  
 Encysted hydrocele of cord, 476  
 Endoscope, Kelly's, 68  
     Luy's, 69  
     in ureteral catheterization, Kelly's, 84  
     Kelly-Pawlik, 85  
     Luy's, 85  
 Endoscopic tubes, 68  
 Endo-urethral chancre, 162  
 Enlargement of prostate, 575  
 Epididymectomy, technic of, 528  
 Epididymis, anatomy of, 422

Epididymis, blood supply of, 425  
 histology of, 425  
 lymphatics of, 426  
 nerves of, 426  
 physiology of, 426  
 tuberculosis of, 498, 499  
   diagnosis of, 499  
   pathology of, 511  
   prognosis of, 499  
   symptoms of, 519  
   treatment of, 499  
 Epididymitis, gonorrheal, 330  
   diagnosis of, 331  
   etiology of, 330  
   pathology of, 330  
   prognosis of, 331  
   sterility in, 334  
   stricture of urethra and, 392  
   symptoms of, 330  
   treatment of, 331  
     operative, 332  
     vaccines in, 332  
 Epididymovasectomy, technic of, 528  
 Epispadias, 213  
   etiology of, 214  
   in female, 351  
     treatment of, 351  
   operations for, 214  
     Beck's, 216  
     Duplay's, 214  
     Thiersch's, 214  
   treatment of, 214  
 Epithelial cysts of penis, 236  
 Erosive balanitis, 264  
 Erysipelas of penis, 232  
   of scrotum, 453  
 Erythema intertrigo of scrotum, 450  
 Essential hematuria, 184  
 Esthiomène, 260  
   causes of death in, 261  
   course of, 261  
   diagnosis of, 261  
   pathology of, 262  
   symptoms of, 261  
   treatment of, 263  
 Evacuating apparatus, Bigelow's, 40, 41  
 Eversion in treatment of hydrocele, 471  
 Extravaginal spermatocele, 477

**F**

FASCIA of penis, anatomy of, 196  
 Fibroma of penis, 237  
 Filarial elephantiasis of scrotum, 454  
 Fistula in genital tuberculosis, 520  
 Follicular prostatitis, pathology of, 300  
 Foreign bodies, removal of, operative  
   cystoscopy and, 90  
   stricture of urethra and, 416  
 Fourth venereal disease, 264  
 Freezing of penis, 225  
 Frenum of penis, disease of, 223

**G**

GALACTOCELE, 477  
 Gall-stones, roentgenology of urinary tract and, 151  
 Galvanocautery in treatment of caruncle of female urethra, 359  
 Gangrene of penis, 234  
   of scrotum, 453  
 Gangrenous balanitis, 264  
 Genital tuberculosis, 498  
   bladder in, 521  
   diagnosis of, 523  
   etiology of, 517  
   fever in, 521  
   fistula in, 520  
   incidence of, 500  
   pain in, 520  
   pathogenesis of, 503  
   pathology of, 509  
   prognosis of, 524  
   sex function in, 522  
   symptoms of, 519  
   treatment of, 527  
   urine in, 521  
 ulcers, 240  
   classification of, 241  
   historical review of, 240  
   non-venereal, 277  
   venereal, 241  
     chancroid, 278  
     erosive and gangrenous  
       balanitis, 264  
     syphilis, 241  
       chancre, 241  
       esthiomène, or syphil-  
       itic hypertrophy of  
       vulva with ulcerations,  
       260  
       gumma or chancre re-  
       dux, 259  
       ulcerative papule, 259  
 Genitals, diseases of, symptoms of, 144  
 Genito-urinary diseases, symptoms of,  
   141  
   genital, 144  
   physical examination of  
     women, 145  
   prostatic, 142  
   of chancre, 250, 251  
   renal pelvic, 143  
   seminal vesicular, 142  
   ureteral, 142  
     in female, 144  
   urethral, 141  
     vesical, 142  
   organs, syphilis of, 161  
   tuberculosis, incidence of, 500  
 Giemsa's staining methods in diagnosis  
   of chancre, 250, 251  
 Giralde's organ of, 417  
 Glands, Cowper's, anatomy of, 289  
   of Littre, anatomy of, 289  
   prostate, anatomy of, 289  
   urethral, abscess of, anterior gonor-  
     rheal urethritis and, 304  
   anatomy of, 289

- Glandular hypospadias, operations for, 204
- Goldschmidt's cysto-urethroscope, 96
- Gonococcal infection of bladder, 334  
of kidney, 334
- Gonococcus, 292  
appearance of, atypical, 293  
typical, 293  
collection of material for examination, 295  
complement-fixation test and, 296  
cases used in, 297  
effect of vaccines on, 297  
practical value of, 298  
time of appearance, 297  
of disappearance, 297  
weakly positive, 297  
cultural methods, 295  
fixing of, 293  
isolation of, 294  
microscopic characteristics of, 292  
preparation of slide, 292  
source of specimen of, 292  
spreading on slide, 292  
staining of, 293  
Gram stain in, 294  
methylene blue, 293
- Gonorrhea, 286  
acute anterior. *See* Gonorrheal urethritis, acute anterior.  
diagnosis of, methylene blue stain in, 293  
posterior. *See* Gonorrheal urethritis, acute posterior.  
chronic, diagnosis of, methylene blue stain in, 294  
prevalence of, 286  
reasons for, 286  
remedy for, 287  
treatment of, 313. *See* Gonorrheal urethritis, treatment of.
- Gonorrheal epididymitis, 330  
diagnosis of, 331  
etiology of, 330  
pathology of, 330  
prognosis of, 331  
sterility in, 333  
symptoms of, 330  
treatment of, 331  
operative, 332  
vaccines in, 332
- prostatitis, acute, pathology of, 300  
chronic, complement-fixation test in, 311  
course of, 311  
diagnosis of, 311  
from inflammation of verumontanum, 312  
from non-gonorrheal prostatitis, 312  
from seminal vesiculitis, 312
- stricture of urethra, 386  
course of, 393  
cure of, 393
- Gonorrheal stricture of urethra, diagnosis of, 394  
epididymitis and, 392  
etiology of, 386  
form of, 388  
location of, 387  
pathology of, 386  
treatment of, 397  
anesthesia in, 398  
antisepsis in, 398  
bougies in, 398  
dilatation in, 398  
meatotomy in, 403  
operative, 402  
palliative, 397  
preventive, 397  
resection of fistula, 412  
of urethra, 411  
sounds in, 399  
urethrotomy in, external, 405, 409  
internal, 404
- urethritis, acute anterior, abscess of urethral glands and, 309  
balanoposthitis and, 305  
burning on urination in, 303  
cavernositis and, 305  
course of, 304  
diagnosis of, 304  
discharge in, 303  
incubation in, 302  
inguinal adenitis and, 305  
invasion in, 302  
lymphangitis and, 305  
painful erections in, 303  
peri-urethral abscess and, 304  
peri-urethritis and, 304  
red and swollen meatus in, 303  
spongeitis and, 305  
symptoms of, 302  
urine changes in, 303  
variations in attack of, 303  
etiology of, 298  
pathology of, 299  
posterior, acute seminal vesiculitis and, 307  
complications of, 306  
course of, 306  
cowperitis and, 306  
frequency of urination in, 305  
prostatic abscess and, 306  
symptoms of, 305  
urinary change in, 306
- case treatment of, 319  
chronic anterior, cause of, 307

- Gonorrheal urethritis, chronic anterior, complement-fixation test in, 309  
 complications of, 309  
 diagnosis of, 309  
 instrumentation, 308  
 pain in, 308  
 palpation in, 308  
 symptoms of, 307  
 urethral discharge in, 308  
 urethroscopy in, 308  
 urine in, 308  
 pathology of, 301  
 posterior, complications of, 312  
 disturbances in sexual functions in, 310  
 of urination in, 310  
 etiology of, 309  
 exacerbations in, 310  
 instrumentation in, 311  
 pain in, 310  
 palpation in, 310  
 pus in urine in, 310  
 symptoms of, 309  
 urethral discharge in, 310  
 urethroscopy in, 311  
 in female, 370  
 acute, 373  
 complications of, 378  
 cystitis and, 378  
 etiology of, 373  
 examination in, 374  
 suburethral abscess and, 379  
 symptoms of, 373  
 treatment of, 376  
 urethroscopy in, 375  
 chronic, 379  
 diagnosis of, 381  
 pathology of, 380  
 symptoms of, 380  
 treatment of, 382  
 urethroscopy in, 381  
 urine in, 381  
 examination for, 371  
 pyuria without urethral discharge in, 371  
 prophylaxis against, 313  
 treatment of, 313  
 anodynes in, 315  
 anterior urethral injections in, 315  
 antigenococcus serum in, 327  
 balsamics in, 314  
 bowels in, 314  
 bulbous bougie in, 317  
 dilatation in, 317  
 discharge in, 314  
 food in, 314  
 hygienic cleanliness in, 314  
 internal medication in, 314  
 Gonorrheal urethritis, treatment of, posterior urethral irrigation in, 316  
 prostatic massage in, 316  
 rest in, 314  
 urethral instillations in, 318  
 vaccinees in, 327  
 Gouley's tunnelled sound, 54  
 Gross, Samuel D., historical sketch of, 21  
 Guinea-pig inoculation, diagnosis of lesions of urinary tract and, 134  
 Gumma of kidney, 190  
 Wassermann reaction in, 191  
 of penis, 235, 259  
 Gunshot wounds of penis, 219
- ## H
- HAGNER hemostatic bag, 625  
 Hard chancre, 241  
 Hematocele, 442, 476  
 diagnosis of, 476  
 from hydrocele, 467  
 etiology of, 476  
 spontaneous, 476  
 symptoms of, 476  
 traumatic, 476  
 treatment of, 477  
 Hematoma of scrotum, 449  
 Hematuria in carcinoma of prostate, 673  
 essential, 184  
 in syphilis of bladder, 182  
 Hernia, diagnosis of, from hydrocele, 467  
 Hernial sac, hydrocele of, 476  
 Herpes progenitalis, 231, 278  
 diagnosis of, 278  
 etiology of, 278  
 inguinal adenitis and, 232  
 symptoms of, 278  
 treatment of, 232, 278  
 Herpetic urethritis, 334  
 High-frequency spark operation in obstruction of prostate, 609  
 Historical sketch of genito-urinary surgery in America, 17  
 Hunterian chancre, 241  
 Hydatid of Morgagni, 417  
 Hydrocele, 461  
 acute, 462  
 course of, 462  
 diagnosis of, 463  
 symptoms of, 463  
 treatment of, 463  
 anatomy of, 461  
 chronic, 463  
 complications of, 467, 472, 473  
 diagnosis of, 466  
 from chylocele, 467  
 from hematocele, 467  
 from hernia, 467  
 from solid tumor, 467  
 from spermatocoele, 467  
 light test in, 466

- Hydrocele, chronic, diagnosis of, puncture in, 466  
 epididymis and, 465  
 etiology of, 463  
 fluid in, 464  
   amount of, 464  
   examination of, 465  
   properties of, 464  
 pathology of, 464  
 prognosis of, 467  
 rupture and, 467  
 sac in, 465  
 suppuration in, 467  
 symptoms of, 465  
 testis and, 465  
 trauma and, 463  
 treatment of, 468  
   Andrew's "bottle" operation in, 471  
   aspiration in, 470  
   autoserotherapy in, 468  
   eversion in, 471  
   excision in, 472  
   open operations in, 471  
   operative, 474  
   tapping in, 469  
   vaccine therapy in, 468  
   Winkelmann's operation in the, 472  
 congenital, 475  
   diagnosis of, 475  
   prognosis of, 475  
   treatment of, 475  
 of cord, 475  
   diagnosis of, 475  
   diffuse, 475  
   encysted, 476  
     treatment of, 476  
   symptoms of, 475  
   treatment of, 476  
 definition of, 461  
 due to abnormalities of development, 474  
 of a hernial sac, 476  
   treatment of, 476  
 idiopathic, 463  
 infantile, 475  
   treatment of, 475  
 varieties of, 461  
 Hypertrophy of prostate, cancer and, 662  
   of testicle, 430  
 Hypospadias, 202  
   etiology of, 204  
   in female, 350  
     symptoms of, 350  
     treatment of, 351  
   glandular, operation for, 204  
     Beck's, 204  
     Duplay's, 204, 206  
   penoscrotal, operation for, 207  
     Beck's, 208  
     Duplay's, 207  
   perineal, operations for, 209  
     Nové-Josserand's, 209  
     Rochet's, 211  
   treatment of, 204
- I**
- Idiopathic hydrocele, 463  
 orchitis, 486  
 varicocele, 479  
 Incised wounds of penis, 219  
 Indigo-carmin in functional tests of kidneys, 128  
 Indirect catheterizing cystoscopes, 66  
   cystoscopes, 65  
     in ureteral catheterization, 79  
     optical system, 60  
 Infantile hydrocele, 475  
 Infiltration of Oberlander, 301  
 Inflammation of penis, 230  
   of scrotum, 452  
   of urethra in female, 368  
   of verumontanum, diagnosis of, from chronic gonorrheal prostatitis, 312  
 Ingestive urethritis, 334  
 Inguinal adenitis, 283  
   acute anterior gonorrheal urethritis and, 305  
   etiology of, 284  
   in herpes progenitalis, 231  
   pain in, 284  
   symptoms of, 284  
   treatment of, 284  
   bubo, 283  
 Interventricular space, cancer of prostate and, 678  
 Intestine shadows, roentgenology of urinary tract and, 150  
 Intravaginal spermatocele, 477  
 Intravesical biopsy, operative cystoscopy and, 91
- K**
- Kelly's cystoscope, 349  
 endoscope, 68  
   in ureteral catheterization, 84  
 urethroscope, 349  
 Kelly-Pawlik endoscope in ureteral catheterization, 85  
 Keyes's deep urethral syringe, 319  
   Edward L., historical sketch of, 27  
 Kidney drainage of, Watson's apparatus for, 45, 46  
 Kidneys, functional tests of, 126  
   indigo-carmin in, 128  
   methylene blue in, 128  
   phenolsulphonaphthalein in, 129  
     technic of, 130  
   phloridzin in, 128  
     variability of, 126  
   gonococcal infection of, 334  
   gumma of, 190  
     prognosis of, 191  
     symptoms of, 191  
     urine in, 191  
     Wassermann reaction in, 191  
   infection of, gonorrheal stricture of urethra and, 392

Kidneys, pelvis of, capacity of, 125  
diseases of, symptoms of, 143  
obstruction of, diagnosis of, 140  
syphilis of, 184  
Kollman posterior urethral dilator, 318

**L**

LACERATED wounds of penis, 219  
Levaditi's staining methods in diagnosis of chancre, 251, 252  
Lewis's universal cystoscope, 63  
Lipoma of penis, 237  
Litholapaxy, historical sketch of, 39  
Lithotrite, Bigelow's, 40, 41  
Littré, glands of, anatomy of, 289  
Lupus of scrotum, 451  
Luy's endoscope, 69  
in ureteral catheterization, 85  
Lymphadenitis, chaneroid and, 283  
Lymphangitis, acute anterior gonorrheal urethritis and, 305  
chaneroid and, 283  
in inflammation of penis, 231  
Lymphatics of penis, anatomy of, 198

**M**

McCarthy's close vision cysto-urethro-scope, 348  
Magnification in direct optical system, 59  
Malformations of penis, congenital, 198  
of testicle, 428  
of urethra in female, 349  
Malposition of urethra in female, 350  
Meatotomy in gonorrheal stricture of urethra, 403  
ureteral, operative cystoscopy and, 91  
Meatus, chancre of, 161  
Membranous urethra, anatomy of, 288  
cancer of prostate and, 679  
Mercier bicoudé catheter, 582  
coudé catheter, 582  
Methylene blue in functional tests of kidneys, 128  
Morgagni, hydatid of, 417  
Mumps, orchitis and, 486  
Muscles of penis, anatomy of, 197

**N**

NEOPLASMS of scrotum, 459  
of urethra in female, 357, 362  
Nephrectomy, historical sketch of, 36  
Nephritis, syphilitic, acute parenchymatous, 185  
anemia in, 188  
diagnosis of, 188  
dropsy in, 188  
etiology of, 185  
pathology of, 187  
prognosis of, 189

Nephritis, syphilitic, acute parenchymatous, salvarsan in, 190  
symptoms of, 188  
synonyms of, 185  
treatment of, 189  
urinary findings in, 187, 188  
urine in, 188  
Wassermann reaction in, 188  
precox, 185

Nephrolithotomy, historical sketch of, 36  
Nephropexy, historical sketch of, 37  
Nephroptosis, pyclography and, 155  
Nernst lamp in diagnosis of chancre, 248  
Nerves of penis, anatomy of, 198  
Nitze cystoscopes, 60, 62  
(direct) optical system, amplification of fields in, 58  
Nitze-Albarran catheterizing cystoscope, 66  
Noguchi butyric acid test in diagnosis of chancre, 255  
Non-gonococcal urethritis in female, 368  
treatment of, 369  
Non-gonorrheal prostatitis, diagnosis of, from chronic gonorrheal prostatitis, 312  
urethritis, 334  
treatment of, 334  
Non-venereal genital ulcers, 277  
Nové-Josserand's operation for perineal hypospadias, 209

**O**

OBERLANDER, infiltration of, 301  
Olivary bougie, 317  
Operative cystoscopy, 85  
Optical system, direct, amplification of fields in, 58  
magnification in, 59  
properties of, 58  
indirect, 60  
prismatic, 60  
Orchitis, idiopathic, 486  
mumps and, 482  
smallpox and, 486  
tonsillitis and, 486  
typhoid fever and, 485  
Organ of Giralde, 417  
Osteophytes, roentgenology of urinary tract and, 150  
Otis's urethrotome and steel sound, 52  
Otis-Brown-Nitze prismatic cystoscope, 65  
Oudin spark in treatment of caruncle of female urethra, 359

**P**

PAIN in carcinoma of prostate, 672  
in chancre, 245

- Pain in chancroid, 281  
 in chronic anterior gonorrheal urethritis, 308  
 in endo-urethral chancre, 162  
 in genital tuberculosis, 520  
 in gonorrheal stricture of urethra, 392  
 in inguinal adenitis, 284  
 in syphilis of bladder, 182  
 in torsion of testicle, 444
- Painful erections in acute anterior gonorrheal urethritis, 303
- Papilloma of penis, 237  
 of urethra in female, 360
- Paradidymis, 417
- Paraphimosis, 225  
 chancroid and, 283  
 treatment of, 226
- Parenchymatous prostatitis, pathology of, 300  
 syphilitic nephritis, acute, 185
- Pediculi pubis of scrotum, 451
- Penile urethra, anatomy of, 288
- Penis, absence of, 201  
 actinomycosis of, 236  
 adherent, 202  
 anatomy of, 193  
 arteries of, anatomy of, 197  
 burns of, 229  
 carcinoma of, 237  
   diagnosis of, 239  
   phimosis and, 224, 237  
   symptoms of, 239  
   treatment of, 239  
 cartilaginous and bony formation of, 234  
 chancre of, 241  
   chancrous erosions, 245  
   ulceration, 245  
   classification of, 244  
   definition of, 241  
   diagnosis of, 247  
     dark-ground illuminator in, 247  
     Nernst lamp, 248  
     Reichert instrument, 248  
   differential, 255  
   Noguchi butyric acid test in, 255  
   obtaining material for, 249  
   preparation of materials for, 249  
   Ross-Jones modification of Nonne test in, 255  
   spinal fluid examination in, 254, 255  
   staining methods in, 250  
     Giemsa's, 250, 251  
     Levaditi's, 251  
   Wassermann reaction in, 253, 254  
   etiology of, 241  
   histology of, 243  
   incubation in, 244  
   indurated papule, 245
- Penis, chancre of, indurated papule, Hunterian, 245  
 parchment, 245  
 pain in, 245  
 pathology of, 243  
 prognosis of, 256  
 prophylaxis in, 256  
*Spirochaeta pallida* in, 241  
 synonyms of, 241  
 treatment of, 256  
   excision in, 256  
   general, 256  
   local, 256  
   salvarsan in, 256
- chondroma of, 237  
 cleft, 202  
 concealed, 201  
   treatment of, 201  
 condyloma of, 237  
 congenital malformations of, 198  
 contusions of, 218  
   treatment of, 218  
 cysts of, dermoid, 237  
   epithelial, 236  
 dartos of, anatomy of, 196  
 diseases of, 223  
 dislocation of, 220  
   treatment of, 221  
 double, 199  
   treatment of, 201  
 edema of, 230  
 elephantiasis of, 236  
 epispadias, 213  
   etiology of, 214  
   treatment of, 214  
 erysipelas of, 232  
 fascia of, anatomy of, 196  
 fibroma of, 237  
 freezing of, 229  
 frenum of, disease of, 223  
   treatment of, 223  
 gangrene of, 234  
   treatment of, 234  
 gumma of, 235, 259  
 herpes of, 231  
 hypospadias of, 202  
   etiology of, 204  
   treatment of, 204  
 inflammation of, 230  
   balanoposthitis in, 231  
   etiology of, 231  
   lymphangitis in, 231  
   symptoms of, 231  
   treatment of, 231  
 injuries of, 218  
   subcutaneous, 226  
     diagnosis of, 227  
     prognosis of, 227  
     symptoms of, 227  
     treatment of, 227  
 lipoma of, 237  
 lymphatics of, anatomy of, 198  
 muscles of, anatomy of, 197  
 nerves of, anatomy of, 198  
 papilloma of, 237  
 paraphimosis of, 225

- Penis, paraphimosis of, treatment of, 226  
 phimosis, 223. *See* Phimosis.  
 phlegmon of, 232  
   symptoms of, 232  
   treatment of, 232  
 rupture of, 220  
   treatment of, 220  
 sarcoma of, 239  
   diagnosis of, 239  
   prognosis of, 239  
 skin of, affections of, 232  
   anatomy of, 196  
 strangulation of, 221  
   by foreign bodies, 229  
 syphilis of, 241. *See* Genital Ulcers.  
 torsion of, 202  
 tuberculosis of, 234  
   circumcision and, 235  
   pathology of, 516  
   treatment of, 235  
 tumors of, 237  
 ulcerated papule in, 259  
 veins of, anatomy of, 197  
 wounds of, 218, 219  
   gunshot, 219  
   incised, 219  
   lacerated, 219  
   open, 228  
     treatment of, 228  
   punctured, 219  
     treatment of, 219
- Penoscrotal hypospadias, operations for, 207
- Perineal drainage in cancer of prostate, 713  
   hypospadias, operations for, 209  
   prostatectomy in enlargement of prostate, 639  
     after-treatment, 645  
     enucleation of glands in, 643  
     exposure of recto-urethral muscle in, 640  
     incision in, 640  
     results of, 646  
     technic of, 639  
     through median incision, 647  
     wound dressing in, 644
- Peri-urethral abscess, acute anterior gonorrheal urethritis and, 304  
   stricture of female urethra and, 364
- Peri-urethritis, acute anterior gonorrheal urethritis and, 304  
   gonorrheal stricture of urethra and, 392
- Phagedena, chancroid and, 283  
   syphilis of urethra and, 167
- Phenolsulphonephthalein in functional tests of kidneys, 129
- Phimosis in adults, 224  
   atrophic, 224  
   balanoposthitis in, 224
- Phimosis, carcinoma and, 227, 237  
   chancroid and, 282  
   in children, 224  
   congenital, 223  
     treatment, 225  
   preputial stones and, 225
- Phleboliths, roentgenology of urinary tract and, 150
- Phlegmons of penis, 232
- Phloridzin in functional tests of kidneys, 128
- Phosphatic encrustations, removal of, operative cystoscopy and, 90
- Pigmented moles, roentgenology of urinary tract and, 150
- Pileher hemostatic bag, 626  
   modification of de Pezzer catheter, 615
- Pityriasis versicolor of scrotum, 451
- Pollakiuria in syphilis of bladder, 182
- Polyorchism, 429
- Polypi of urethra in female, 360
- Postgonorrheal urethritis, 334
- Posthitis, 230
- Preputial stones, phimosis and, 225
- Priapism in diffuse cavernositis, 233
- Primary sclerosis, 241
- Prismatic cystoscopes, 65  
   Buerger's, 65  
   Otis-Brown-Nitze, 65  
   optical system, 60
- Prolapse of urethra in female, 354  
   treatment of, 355
- Prostate, anatomy of, 541, 543, 554  
   bloodvessels of, 546  
   calculus disease of, 723  
     etiology of, 723  
     symptoms of, 723  
     treatment of, 724  
   cancer of, 657  
     bladder and, 680  
     Bottini electrocautery operation in, 712  
     castration in, 713  
     catheter life in, 672  
     catheterization in, 713  
     course of, 671  
     diagnosis of, 669  
       from obstruction, 589  
     duration of, 674  
     etiology of, 658  
     frequency of, 657  
     hematuria in, 673  
     histology of, 660  
     hypertrophy and, 662  
     intervascular space and, 678  
     loss of weight in, 673  
     membranous urethra and, 679  
     pain in, 672  
     pathology of, 659  
     perineal drainage in, 713  
     physical signs in, 674  
     prostatectomy in, partial, 697  
       suprapubic, 711  
     radical operation for, 682  
     radium in treatment of, 715

- Prostate, cancer of, rectal examination  
     in, 675  
     rectum and, 679  
     seminal vesicles and, 678  
     stricture of prostatic urethra  
         and, 681  
     subtotal radical incision in, 698  
     suburethral thickening and, 681  
     suprapubic drainage in, 713  
     symptoms of, 665  
     treatment of, 681  
     diseases of, symptoms of, 142  
     embryology of, 541  
     enlargement of, 575  
         bladder in, 578  
         etiology of, 576  
         kidneys in, 578  
         occurrence of, 575  
         ureters in, 578  
         urethra in, 576  
     gland, anatomy of, 289  
     histology of, 546  
     hypertrophy of, cancer and, 602  
     lateral aponeurosis of, 544  
     lymphatics of, 546  
     muscular apparatus of, 550  
     nerve supply of, 551  
     nerves of, 546  
     obstruction of, 553, 617  
         cystoscopy in, 584  
             dangers of, 587  
             technic of, 584  
             value of, 586  
         diagnosis of, 581  
             from carcinoma, 589  
             from chronic prostatitis,  
                 588  
             from retention of urine due  
                 to spinal disease, 589  
             from tuberculosis, 588  
             from vesical calculus, 590  
             tumors, 589  
             history in, 581  
         drainage operation in, 615  
         enucleation of prostate in, 620  
         examination in, 582  
         high-frequency spark operation  
         in, 609  
         prostatectomy in, 600  
             epididymitis and, 603  
             fistulae and, 604  
             hemorrhage in, 630  
                 control of, 630-632  
             impotence and, 603  
             incontinence of urine and,  
                 603  
             orchitis and, 603  
             perineal, 639  
                 after-treatment in, 645  
                 enucleation of gland  
                     in, 643  
                 exposure of recto-ure-  
                     thral muscle in, 640  
                 incision in, 640  
                 results of, 646  
                 technic of, 639
- Prostate, obstruction of, prostatectomy  
     in, perineal, through  
         median incision, 647  
         wound dressing in, 644  
     transvesical, 610  
         by open method, 636  
     urethral stricture and,  
         605  
     rectal examination in, 584  
     suprapubic cystostomy in, 611  
         technic of, 613  
         drainage of bladder in, 633  
     symptoms of, 579  
     treatment of, 590  
         of acute retention of urine,  
             591  
         of cystitis with urinary  
             stasis, 591  
         hygienic, 590  
         intermittent catheterism  
             in, 593  
         intra-urethral, 592  
         palliative, 593  
         preliminary to prostatec-  
             tomy, 600  
         prostatectomy in, 600  
         surgical indications in, 595  
         x-ray examination in, 587  
         Young punch operation in, 608  
     pathology of, 554  
         gross, 555  
     physiology of, 549  
     sarcoma of, 720  
         symptoms of, 721  
         treatment of, 721  
     secretion of, 549  
     surgery of, historical sketch of, 47  
     syphilis of, 168  
     tuberculosis of, diagnosis of, from  
         obstruction, 588  
         pathology of, 514  
         symptoms of, 521
- Prostatectomy in cancer of prostate, par-  
     tial, 697, 698  
     suprapubic, 711  
     in enlargement of prostate, 600  
     epididymitis and, 603  
     fistulae and, 604  
     hemorrhage in, 630  
         control of, 630-632  
     impotence and, 603  
     incontinence of urine and,  
         603  
     orchitis and, 603  
     perineal, 639  
         after-treatment in, 645  
         enucleation of gland  
             in, 643  
         exposure of recto-ure-  
             thral muscle in, 640  
         incision in, 640  
         results of, 646  
         technic of, 639  
         wound drainage in, 644

- Prostatectomy in enlargement of prostate, stricture of urethra and, 605  
     transvesical, 610  
     by open method, 636  
 Prostatic abscess, acute posterior gonorrheal urethritis and, 306  
     gonorrheal stricture of urethra and, 392  
     calculi, pyelography and, 159  
     tractors, 642  
     urethra, anatomy of, 288  
     stricture of, cancer of prostate and, 681  
 Prostatitis, catarrhal, pathology of, 300  
     chronic, diagnosis of, from obstruction, 588  
     pathology of, 301  
     follicular, pathology of, 300  
     gonorrheal, complement-fixation test in, 311  
     course of, 311  
     diagnosis of, 311  
     stricture of urethra and, 392  
     non-gonorrheal, diagnosis of, from gonorrheal prostatitis, 312  
     parenchymatous, pathology of, 300  
 Pruritus of scrotum, 451  
 Punctured wounds of penis, 219  
 Pyelography, 155  
     dangers of, 124  
     dark-room technic of, 160  
     diverticula of bladder and, 160  
     exposure for, 160  
     nephroptosis and, 155  
     prostatic calculi and, 159  
     stone in bladder and, 160  
     ureteral calculi and, 159  
     uric acid stones and, 155  
 Pyemia in diffuse cavernositis, 233

**R**

- RADIOGRAMS, interpretation of, 125  
 Radiography in genito-urinary diagnosis, 123  
     preparation of patient for, 126  
     technic and mode of, 126  
     value of, 123  
     stereoscopic, 126  
 Radium in treatment of cancer of prostate, 715  
 Rectal examination in obstruction of prostate, 584  
 Rectum, cancer of prostate and, 679  
 Reichert instrument in diagnosis of chancre, 248  
 Resection of bladder, transperitoneal  
     partial, historical sketch of, 43  
     of fistula in gonorrheal stricture of urethra, 412  
     of urethra in gonorrheal stricture, 411  
     Cabot's, 411  
 Rochet's operation for perineal hypospadias, 211  
 Roentgenology of urinary tract, 147.  
     See also Radiography.  
     concretions in appendix and, 150  
     gall-stones and, 151  
     intestine shadows and, 150  
     osteophytes and, 150  
     phleboliths and, 150  
     pigmented moles and, 150  
     preparation of patient, 147  
     sources of error in, 147  
     technic of, 152  
 Ross-Jones modification of Nonne test in diagnosis of chancre, 255  
 Rupture of penis, 220  
     treatment of, 220

**S**

- SALVARSAN in treatment of acute parenchymatous syphilitic nephritis, 190  
     of chancre, 256  
 Sarcoma of penis, 239  
     of prostate, 720  
 Scabies, diagnosis of, from chancre, 255  
     of scrotum, 451  
 Scrotal hypospadias, operations for, 208  
 Scrotum, abnormalities of, 449  
     abscess of, 452  
     adenocarcinoma of, 460  
     anatomy of, 447  
     areolar tissue of, anatomy of, 448  
     bloodvessels of, 448  
     calculi of, 454  
     carcinoma of, 460  
     cellulitis of, 452  
     chafing of, 450  
     cutaneous diseases of, 450  
     dartos of, anatomy of, 447  
     eczema of, 450  
     marginatum of, 451  
     edema of, 452  
     elephantiasis of, filarial, 454  
     associated conditions in, 456  
     diagnosis of, 456  
     edema in, 456  
     etiology of, 454  
     pathology of, 455  
     prophylaxis in, 457  
     symptoms of, 456  
     treatment of, 457  
     non-filarial, 459  
     emphysema of, 453  
     erysipelas of, 453  
     erythema intertrigo of, 450  
     gangrene of, 453  
     granuloma of pudenda, 453  
     hematoma of, 449  
     inflammation of, 452  
     injuries of, 449  
     loss of substance of, 449

- Scrotum, lupus of, 451  
 lymphatics of, 448  
 neoplasms of, 459  
 nerves of, 449  
 pediculi pubis of, 451  
 pityriasis versicolor of, 451  
 pruritus of, 451  
 scabies of, 451  
 sebaceous cysts of, 452  
 skin of, 447  
 steatoma of, 452  
 suture of, 450  
 syphilis of, 451  
 varicose veins of, 452
- Sebaceous cysts of scrotum, 452
- Seminal vesicles, anatomy of, 291, 546  
 bloodvessels of, 549  
 cancer of prostate and, 678  
 definition of, 546  
 diseases of, symptoms of, 142  
 embryology of, 546  
 histology of, 549  
 physiology of, 549  
 secretion of, 549  
 tuberculosis of, pathology of, 515  
 symptoms of, 521  
 vesiculitis, acute posterior gonorrheal urethritis and, 306  
 gonorrheal stricture of urethra and, 392  
 pathology of, 301  
 symptoms of, 313  
 treatment of, 328  
 operative, 328  
 vasectomy in, 329  
 vasotomy in, 329
- Sex function in chronic posterior gonorrheal urethritis, 310  
 in genital tuberculosis, 522
- Simple ulcer, 278
- Skin of penis, affections of, 232  
 anatomy of, 196  
 of scrotum, anatomy of, 447
- Smallpox, orchitis and, 486
- Soft chancre, 278  
 rubber catheter, 582
- Sounds, use of, in gonorrheal stricture of urethra, 395, 399
- Spermatocele, 477  
 diagnosis of, 478  
 from hydrocele, 457  
 etiology of, 477  
 extravaginal, 477  
 fluid in, 478  
 intravaginal, 477  
 pathology of, 478  
 symptoms of, 478  
 treatment of, 478
- Spinal cord affections simulating syphilis of bladder, 184  
 fluid examination in diagnosis of chancre, 254, 255
- Spirochæta pallida, characteristic features of, as observed with dark-field condenser, 241
- Spirochæta pallida, ends of, 242  
 motility of, 242  
 shape of, 242  
 size of, 242
- Spongeitis, acute anterior gonorrheal urethritis and, 305
- Spontaneous hematocele, 476
- Steatoma of scrotum, 452
- Stereoscopic radiography, 126
- Stone in bladder, pyelography and, 160  
 preputial, phimosis and, 225  
 stricture of urethra and, 416  
 in ureter, symptoms of, 143  
 uric acid, pyelography and, 155
- Strangulation of penis, 221  
 by foreign bodies, 229
- Stricture, treatment of, by electrolysis, opposition to, 53  
 of urethra in female, 364, 416  
 diagnosis of, 365  
 peri-urethral abscess and, 364  
 symptoms of, 364  
 treatment of, 365  
 urethrotomy in, external, 366  
 internal, 365  
 in male, 384  
 bilharzia and, 416  
 carcinoma and, 416  
 chaneroid and, 416  
 classification of, 384  
 congenital, 414  
 clinical types of, 415  
 diagnosis of, 415  
 etiology of, 415  
 pathology of, 415  
 treatment of, 415  
 foreign bodies and, 416  
 gonorrheal, 386  
 chronic urethral discharge in, 390  
 complications of, 392  
 course of, 393  
 cure of, 394  
 diagnosis of, 394  
 epididymitis and, 392  
 etiology of, 386  
 form of, 388  
 hemorrhage in, 391  
 location of, 387  
 onset of, 389  
 pain in, 392  
 pathology of, 386  
 peri-urethritis and, 392  
 prognosis of, 393  
 prostatic abscess and, 392  
 prostatitis and, 392  
 renal infection and, 392  
 symptoms of, 389  
 sexual, 392  
 treatment of, 397  
 anesthesia in, 398  
 antisepsis in, 398  
 bougies in, 398

Stricture of urethra in male, gonorrheal,  
     treatment of,  
     dilatation in,  
     398  
     meatotomy in, 403  
     operative, 402  
     palliative, 397  
     preventive, 397  
     resection of fis-  
     tula, 412  
     of urethra, 411  
     sounds in, 399  
     urethrotomy in,  
     404, 405  
     urination in, 390  
     vesiculitis and, 392  
     statistics of, 385  
     stone and, 416  
     syphilis and, 167, 416  
     traumatic, 412  
         course of, 413  
         pathology of, 413  
         symptoms of, 413  
         treatment of, 414  
         tuberculosis and, 415  
 Suburethral abscess, acute gonorrheal  
     urethritis in female and, 379  
     thickening, cancer of prostate and,  
     681  
 Suprapubic cystostomy in enlargement  
     of prostate, 611  
     drainage of bladder in obstruction of  
     prostate, 633  
     in cancer of prostate, 713  
     prostatectomy in cancer of prostate,  
     711  
 Synorchism, 430  
 Syphilides, urethral mucous, 164  
 Syphilis of bladder, 169  
     pathology of, 181  
     secondary, 173  
         age in, 181  
         cystoscopy in, 181  
         symptoms of, 181  
     tertiary, 175  
         age in, 182  
         cystoscopy in, 182  
         diagnosis of, 182  
         hematuria in, 182  
         pains in, 182  
         pollakinuria in, 182  
         spinal cord affections simu-  
         lating, 184  
         symptoms of, 182  
         treatment of, 183  
     of genito-urinary organs, 161  
     initial lesions of, 241  
     of kidney, 184  
     of penis, 241. *See* Genital Ulcers.  
     of prostate, 168  
     of scrotum, 451  
     stricture of urethra and, 167, 416  
     of ureter, 184  
     of urethra, 161  
         primary, 161  
         chancre of meatus, 161

Syphilis of urethra, primary, complica-  
     tions of, 163  
     diagnosis of, 163  
     endo-urethral chancre, 162  
     frequency of, 161  
     location of, 161  
     secondary, 164  
     tertiary, 164  
         complications of, 167  
         modes of invasion, 165  
         phagedena and, 167  
         prognosis of, 168  
         stricture and, 167  
         symptoms of, 165  
         time of appearance, 165  
         treatment of, 168  
 Syphilitic hypertrophy of vulva with  
     ulceration, 260. *See* Esthiomène.  
 Nephritis, acute parenchymatous, 185  
     anemia in, 188  
     diagnosis of, 188  
     dropsy in, 188  
     etiology of, 185  
     pathology of, 187  
     prognosis of, 189  
     salvarsan and, 190  
     symptoms of, 188  
     synonyms of, 185  
     treatment of, 189  
     urinary findings and,  
     187, 188  
     urine in, 188  
     Wassermann reaction  
     in, 188  
     urethritis, 334  
 Syphiloma of urethra, cylindroid, 165

## T

TAPPING in treatment of hydrocele, 469  
 Testicle, anatomy of, 420  
     blood supply of, 425  
     descent of, 417  
     imperfect, 430  
         diagnosis of, 436  
         effect on testicle, 433  
         incidence of, 431  
         torsion and, 435, 443  
         treatment of, 436  
         Bevan's, 438, 441  
         operative, 437  
     dislocation of, 442  
     ectopia of, 432  
     embryology of, 417  
     histology of, 422  
     infections of, 485  
         diagnosis of, 494  
         etiology of, 485  
         pathogenesis of, 487  
         pathology of, 487, 490  
         prognosis of, 495  
         symptoms of, 494  
         syphilis and, 486  
         treatment of, 496  
     injuries of, 442

- Testicle, luxation of, 432, 442  
   lymphatics of, 426  
   malformations of, 428  
     anorchism, 430  
     atrophy, 430  
     hypertrophy, 430  
     polyorchism, 429  
     synorchism, 430  
   nerves of, 426  
   physiology of, 426  
   torsion of, 443  
     age and, 443  
     cause of, 443  
     diagnosis of, 444  
     edema of skin in, 444  
     incidence of, 443  
     pain in, 444  
     pathology of, 443  
     symptoms of, 444  
     treatment of, 445  
     undescended testicle and, 435, 443  
   tuberculosis of, pathology of, 511  
     symptoms of, 522  
   tumors of, 534  
     clinical picture of, 536  
     diagnosis of, 536  
     etiology of, 534  
     frequency of, 534  
     pathology of, 534  
     prognosis of, 537  
     trauma and, 534  
     treatment of, 538  
   undescended, 430  
     diagnosis of, 436  
     effect of, on testicle, 433  
     incidence of, 431  
     torsion and, 435, 443  
     treatment of, 436  
       operative, 437  
       Bevan's, 438-441
- Testis, anatomy of, 422  
 Thiersch's operation for epispadias, 214  
 Tonsillitis, orchitis and, 486  
 Torsion of penis, 202  
   of testicle, 443  
 Transperitoneal total cystectomy, historical sketch of, 43  
 Transvesical prostatectomy in enlargement of prostate, 610  
   by open method, 636  
 Traumatic hematocoele, 476  
   stricture of urethra in male, 412  
   urethritis, 334  
 Tubercle bacilli in urine, absence of, in diagnosis of lesions of urinary tract, 133  
 Tuberculin tests, diagnosis of lesions of urinary tract and, 134  
 Tuberculosis of epididymis, 498  
   diagnosis of, 499  
   pathology of, 511  
   prognosis of, 499  
   symptoms of, 519  
   treatment of, 499  
   genital, 498  
     bladder in, 521
- Tuberculosis, genital, etiology of, 517  
   fever in, 521  
   fistula in, 520  
   incidence of, 500  
   pain in, 520  
   pathogenesis of, 503  
   pathology of, 509  
   sex function in, 522  
   symptoms of, 519  
   urine in, 521  
   genito-urinary, incidence of, 500  
   of penis, 234  
     circumcision and, 235  
     pathology of, 516  
     treatment of, 235  
   of prostate, diagnosis of, from obstruction, 588  
     pathology of, 514  
     symptoms of, 521  
   of seminal vesicles, pathology of, 515  
     symptoms of, 521  
   stricture of urethra and, 415  
   of testicle, pathology of, 511  
     symptoms of, 522  
   of urethra, pathology of, 516  
   of vas deferens, pathology of, 515  
     symptoms of, 522
- Tumors of bladder, diagnosis of, from obstruction of prostate, 589  
   operations for, historical sketch of, 43  
   of penis, 237  
   of testicle, 534
- Tunica vaginalis, anatomy of, 421  
 Typhoid fever, orchitis and, 485
- ## U
- ULCERS, genital, 240. *See* Genital Ulcers.  
 Ulcus durum, 241  
   molle, 278  
 Undescended testicle, 430  
 Universal catheterizing cystoscope, 68  
 Ureter, diseases of, symptoms of, 142  
   obstruction of, diagnosis of, 140  
   stone in, symptoms of, 143  
   syphilis of, 184  
 Ureteral calculi, descent of, operative cystoscopy and, 90  
   diagnosis of, operative cystoscopy and, 88  
   pyelography and, 159  
   catheterization, 79, 122  
   cystoscope in, direct, 83  
     Elsner-Braasch, 84  
     indirect, 79  
   endoscope in, Kelly's, 84  
     Kelly-Pawlik, 85  
     Luy's, 85  
   lack of drainage after, 123  
   obstructions in, 123  
   wax-tip bougies in, 122  
   implantation, historical sketch of, 44  
   meatotomy, operative cystoscopy and, 91

- Ureterocele, operations on, operative cystoscopy and, 91  
 Urethra, cylindroid syphiloma of, 165  
   in enlargement of prostate, 576  
   examination of, instrumental, 116  
     anesthesia in, 117  
   female, absence of, 349  
     anatomy of, 336  
     anesthesia of, 343  
     calculus of, 356  
       diagnosis of, 356  
       symptoms of, 356  
       treatment of, 357  
   carcinoma of, 362  
   caruncle of, 358  
     pathology of, 358  
     symptoms of, 358  
     treatment of, 359  
   catheter-trauma of, 353  
   catheterization of, 353  
   cysts of, 360  
   diseases of, symptoms of, 141  
   diverticulum of, 366  
     symptoms of, 367  
     treatment of, 367  
   double, 350  
   examination of, 341  
     instruments for, 344  
   inflammations of, 368  
   injuries of, 352  
   inspection of, 342  
   malformations of, 349  
   malposition of, 350  
   neoplasms of, 357  
     benign, 357  
     malignant, 358, 362  
   palpation of, 342  
   papilloma of, 360  
     treatment of, 362  
   physiology of, 339  
   polyp of, 360  
   prolapse of, 354  
     treatment of, 355  
   stricture of, 364  
     diagnosis of, 365  
     peri-urethral abscess and, 364  
       symptoms of, 364  
       treatment of, 365  
     urethrotomy in, 365, 366  
   urethroscopy of, 344  
   male, anatomy of, 287  
     anterior, comparison with posterior, 292  
     diseases of, symptoms of, 141  
     glands of, 289  
     interior of, 289  
     landmarks of, 288  
     membranous, 288  
       cancer of prostate and, 679  
   penile, 288  
   posterior, comparison with anterior, 292  
   prostatic, 288  
     cancer of prostate and, 681  
   size of, 289
- Urethra, male, stricture of, 384  
   bilharzia and, 416  
   carcinoma and, 416  
   chaneroid and, 416  
   classification of, 384  
   congenital, etiology of, 415  
     pathology of, 415  
     treatment of, 415  
   foreign bodies and, 416  
   gonorrheal, 386  
     chronic urethral discharge in, 390  
     complications of, 392  
     congenital, 414  
     course of, 393  
     cure of, 393  
     diagnosis of, 394  
     epididymitis and, 392  
     etiology of, 386  
     forms of, 388  
     hemorrhage in, 391  
     location of, 387  
     onset of, 389  
     pain in, 392  
     pathology of, 386  
     peri-urethritis and, 392  
     prostatic abscess and, 392  
     renal infection and, 392  
     sexual symptoms in, 392  
     symptoms of, 389  
     traumatic, 412  
     treatment of, 397  
       anesthesia in, 398  
       antisepsis in, 398  
       bougies in, 398  
       dilatation in, 398  
       meatotomy in, 403  
       operative, 402  
       palliative, 397  
       preventive, 397  
       resection of fistula, 412  
       of urethra, 411  
       sounds in, 399  
       urethrotomy in, 404, 405, 409  
     urination in, 390  
     vesiculitis and, 392  
   statistics of, 385  
   syphilis and, 167, 416  
   tuberculosis and, 415  
   surgery of, historical sketch of, 51  
   syphilis of, 161  
   primary, 161  
     chancre of meatus, 161  
       symptoms of, 162  
     complications of, 163  
     diagnosis of, 163  
     endo-urethral chancre, 162  
       symptoms of, 166  
     frequency of, 161  
     location of, 161  
   secondary, 164  
   tertiary, 164  
     complications of, 167  
     modes of invasion, 165  
     phagedena and, 167

- Urethra, syphilis of, tertiary, prognosis of, 168  
 strictures and, 167  
 symptoms of, 165  
 time of appearance, 165  
 treatment of, 168  
 tuberculosis of, pathology of, 516
- Urethral discharge in chronic posterior gonorrheal urethritis, 310  
 in gonorrheal stricture of urethra, 390  
 glands, abscess of, acute anterior gonorrheal urethritis and, 304  
 mucous syphilides, 164  
 syringe, 315
- Urethritis, diathetic, 334  
 eczematous, 334  
 in female, acute simple, 368  
   treatment of, 369  
 gonorrheal, 370  
   acute, 373  
     complications of, 378  
     cystitis and, 378  
     etiology of, 373  
     examination in, 374  
     suburethral abscess and, 379  
     symptoms of, 373  
     treatment of, 376  
     urethroscope in, 375  
   chronic, 379  
     diagnosis of, 381  
     pathology of, 380  
     symptoms of, 380  
     treatment of, 382  
     urethroscope in, 381  
     urine in, 381  
   examination for, 371  
   pyuria without urethral discharge in, 371  
 non-gonococcal, 368  
   treatment of, 369  
 gonorrheal, acute anterior, abscess of urethral glands and, 304  
   balanoposthitis and, 305  
   burning on urination in, 303  
   cavernitis and, 305  
   complications of, 304  
   course of, 304  
   diagnosis of, 304  
   discharge in, 303  
   incubation in, 302  
   inguinal adenitis and, 305  
   invasion in, 302  
   lymphangitis and, 305  
   painful erections in, 303  
   pathology of, 299  
   peri-urethral abscess and, 304  
   peri-urethritis and, 304
- Urethritis, gonorrheal, acute anterior, red and swollen meatus in, 303  
 symptoms of, 302  
 spongoitis and, 305  
 urine changes in, 303  
 variations in attack of, 303  
 etiology of, 298  
 posterior, acute seminal vesiculitis and, 307  
 complications of, 306  
 course of, 306  
 cowperitis and, 306  
 frequency of urination in, 305  
 pathology of, 299  
 prostatic abscess and, 306  
 symptoms of, 305  
 urinary changes in, 306  
 case treatment of, 319  
 chronic anterior, cause of, 307  
   complement-fixation test in, 309  
   complications of, 309  
   diagnosis of, 309  
   instrumentation in, 308  
   pain in, 308  
   palpation in, 308  
   symptoms of, 307  
   urethral discharge in, 308  
   urethroscopy in, 308  
   pathology of, 301  
   posterior, complications of, 312  
     disturbances in sexual function in, 310  
     of urination in, 310  
   etiology of, 309  
   exacerbations in, 310  
   instrumentation in, 311  
   pain in, 310  
   palpation in, 310  
   pus in urine in, 310  
   symptoms of, 309  
   urethral discharge in, 310  
   urethroscopy in, 311  
 prophylaxis against, 313  
 treatment of, 313  
   anodynes in, 315  
   antigonococcus serum in, 327  
   balsamics in, 314  
   bowels in, 314  
   bulbous bougie in, 317  
   dilataions in, 317  
   discharge in, 314  
   food in, 314  
   hygienic cleanliness in, 314  
   internal medication in, 314  
   prostatic massage in, 316

- Urethritis, gonorrheal, treatment of,  
     rest in, 314  
     urethral injections in, 315  
     instillations in, 318  
     irrigation in, 316  
     vaccines in, 327  
   herpetic 334  
   ingestive, 334  
   non-gonorrheal, 334  
     treatment of, 334  
   postgonorrheal, 334  
   syphilitic, 334  
   traumatic, 334  
 Urethrocele, 366  
 Urethroscope and light carrier, Young's,  
   347  
   Kelly's, 349  
 Urethroscopes, selection of, 105  
 Urethroscopic picture, normal, of poste-  
   rior urethra, 98  
   pathological, of anterior urethra  
     94  
     of lacunae of Morgagni and  
     Littre's glands, 94  
     of posterior urethra, 95, 101  
 Urethroscopy, 92  
   in chronic anterior gonorrheal ure-  
     thritis, 308  
   posterior gonorrheal urethritis,  
     311  
   in diagnosis of gonorrheal stricture  
     of urethra, 395  
   in female, 105  
     urethra, 344  
   in gonorrheal urethritis in female,  
     375, 381  
   operative, 104  
     in anterior urethra, 104  
     in posterior urethra, 104  
   technic of, 92  
   in treatment of stricture of urethra  
     in female, 365, 366  
 Urethrotome, Otis's, 52  
 Urethrotomy, external with guide, in  
   gonorrheal stricture of ure-  
     thra, 405  
   without guide, in gonorrheal  
     stricture of urethra, 409  
   internal, in gonorrheal stricture of  
     urethra, 404  
 Uric acid stones, pyelography and, 155  
 Urinary findings in acute parenchyma-  
   tous syphilitic nephritis, 187, 188  
   obstruction without enlargement of  
     prostate, 579  
   tract, lesions of, diagnosis of, 107  
     absence of tubercle  
       bacilli in urine and,  
       133  
     cardiovascular exami-  
       nations and, 136  
     change in urine in, 114  
     changes in urinary  
       stream in, 115  
     chemical examination  
       in, 116  
 Urinary tract, lesions of, diagnosis of,  
   cloudy urine and,  
     132  
   complement-fixation  
     test and, 135  
   examination of urine  
     in, 131  
   functional tests in, 123  
   guinea-pig inoculation  
     and, 134  
   history of case in, 112  
   instrumentation in, 116  
   local examination in,  
     115  
   method in quest for,  
     110  
   microscopic examina-  
     tion in, 116  
   physical examination  
     in, 115  
   plan of investigation,  
     112  
   previous personal his-  
     tory in, 113  
   relative value of symp-  
     toms and physical  
     examination for,  
     110  
   tuberculin tests and,  
     134  
   Wassermann tests and  
     136  
   middle, diseases of, diagnosis of,  
     radiography in, 124  
   obstruction of, diagnosis of, 137  
     in bladder, 140  
     in renal pelvis, 140  
     in ureter, 140  
     urethral, 137  
     at vesical neck, 138  
   roentgenology of, 147. *See also*  
     Radiography.  
   upper, diseases of, diagnosis of,  
     radiography in, 124  
 Urination in chronic posterior gonor-  
   rheal urethritis, 310  
   in gonorrheal stricture of urethra,  
     390  
 Urine in acute parenchymatous syphilitic  
   nephritis, 188  
   changes in, in gonorrheal urethritis,  
     303, 306, 381  
   examination of, 131  
   in genital tuberculosis, 521  
   in gummata of penis, 191  
   pus in, in chronic posterior gonor-  
     rheal urethritis, 310  
   retention of, due to spinal disease,  
     diagnosis of, from obstruction of  
     prostate, 589  
   tubercle bacilli in, absence of, in  
     diagnosis of lesions of urinary  
     tract, 133  
 Urogenital mesentery, 422  
 Urologists, associations of, organizations  
   of, 18

Urology in America, evolution of, 34  
contributions of American Surgeons  
to, 35

## V

VACCINE therapy in treatment of hydro-  
cele, 468  
Vaccines in treatment of gonorrheal epi-  
didymitis, 332  
urethritis, 327  
Van Buren, W. H., historical sketch of, 18  
Varicocele, 479  
anatomy of, 479  
idiopathic, 479  
complications of, 482  
diagnosis of, 480  
etiology of, 479  
pathology of, 480  
symptoms of, 480  
treatment of, 480  
operative, 480  
operations on, historical sketch of,  
53  
symptomatic, 479  
diagnosis of, 479  
treatment of, 479  
Varicose veins of scrotum, 452  
Vas deferens, anatomy of, 291  
tuberculosis of, pathology of,  
515  
symptoms of, 522  
Veins of penis, anatomy of, 197  
Venereal ulcer, simple, 278  
warts, 237  
Vesical calculus, operations for, historical  
sketch of, 39

Vesical tumors, operations for, historical  
sketch of, 40  
Vision systems, correct, 61

## W

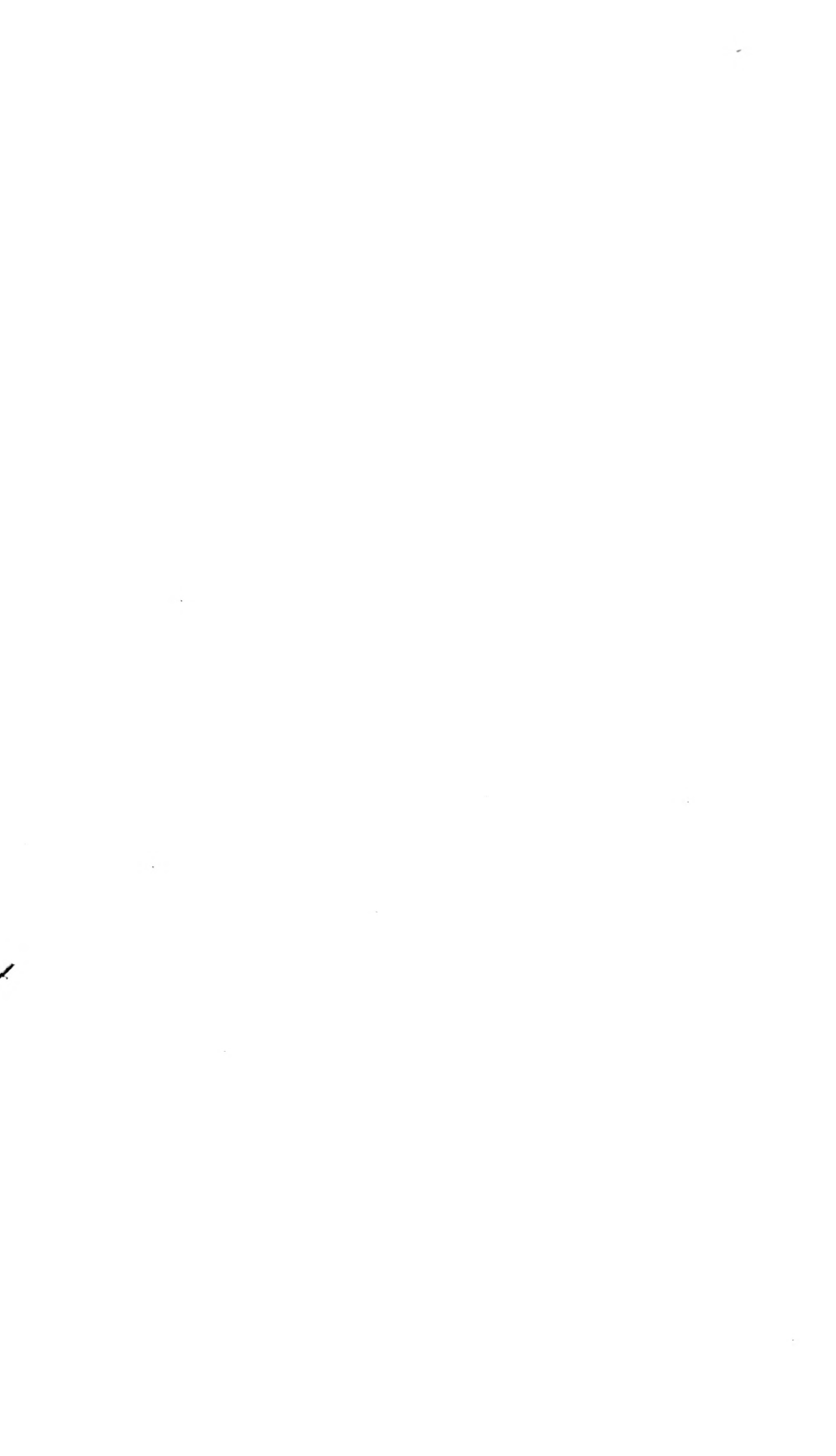
WARTS, venereal, 237  
Wassermann reaction in acute parenchy-  
matous syphilitic nephritis,  
188  
in diagnosis of chancre, 252, 254  
of lesions of urinary tract,  
136  
in gumma of penis, 191  
Watson, Francis S., historical sketch of,  
32  
Watson's apparatus for drainage of kid-  
ney, 45, 46  
bladder speculum, 56  
scissors cautery, 55  
Winkelmann's operation for hydrocele,  
472  
Wounds of penis, 218, 219  
gunshot, 219  
incised, 219  
lacerated, 219  
open, 228  
punctured, 219  
treatment of, 219

## Y

YOUNG's prostatic tractor, 142  
punch operation in obstruction of  
prostate, 608  
urethroscope and light carrier, 347

127

390





**PLEASE DO NOT REMOVE  
CARDS OR SLIPS FROM THIS POCKET**

---

**UNIVERSITY OF TORONTO LIBRARY**

---

**BioMed**

